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RELIABILITY, MAINTAINABILITY, AND LIFE CYCLE COST EFFECTS OF COMMERCIAL OFF-THE-SHELF EQUIPMENT Appendices

Rockwell International Corporation

Norbert E. Schmidt and J. G. Vecellio

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RADC-TR-83-29, Vol II (of two) has been reviewed and is approved for publication.

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*
This report documents the results of a study to determine the effects of using commercial off-the-shelf electronic equipment in a military environment. A key element of confusion in applying commercial technology is understanding what design criteria is a part of such terms as "best commercial practices," etc. The report clarifies how this term and other common ones relate to "militarized." The choice of a militarized vs commercial approach must be done on a case-by-case basis. Therefore, (over)

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rather than firm acquisition strategy being given for all cases, an analytical procedure is presented that may be applied for each unique acquisition situation. Key to making the best decision is the determination of the appropriate weighting for the operational factors necessary for program success as well as the relative weighting of cost and risk. The results indicate that there is merit in considering the use of "best commercial practices" in "ground fixed" and airborne inhabited transport" environments, but it is unlikely that they can be applied successfully in "airborne inhabited fighter" applications. Regardless of the choice of acquisition strategy, use of the guideline technique formalizes management consideration of all factors contributing to the strategy decision and identifies areas of potential risk reduction.

EVALUATION

1. The objective of this study was to develop guidelines indicating the most advantageous class of equipment, militarized or commercial off-the-shelf, for a given military environment. The guidelines were to define for a Program Manager the advantages/disadvantages of each class in terms of reliability, maintainability, cost, risk and other pertinent factors. Precautionary steps that a Program Manager should take to minimize the risks and disadvantages of each class of equipment were to be pointed out for each of the given environments.

2. The objectives have been achieved in a broad sense. Although clearcut decision guidelines could not be developed for all acquisition situations, a procedure tailorable for each unique acquisition situation was formulated. The procedure serves as a guideline in the decision process by forcing the Program Manager to address the risk of achieving success with respect to a variety of program variables. The procedure enables trading off risk against cost and identifies elements for further risk reduction. Terms such as "best commercial practices," "ruggedized" and "militarized" are clarified in terms of how they compare with respect to a series of design disciplines.

3. Use of the procedure introduced will provide a more rigorous process for acquisition decision making. Use of a team of experts in risk quantification is recommended. Clarification of commonly used design descriptions aids the Program Manager in further understanding the risks and payoffs of a particular acquisition decision.

PR MacDiarmid

PRESTON R. MACDIARMID
PROJECT ENGINEER

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APPENDIX 1

INDUSTRIAL SURVEY

A1.0   INTRODUCTION

Appendix 1 contains the results of the industry survey performed
as part of this study. Included is a copy of the cover letter
sent out with the surveys, followed by the results of each survey.
The first page of each survey is listed by company as follows:

COLLINS AVIONICS INDUSTRY SURVEY

Rockwell International, Collins Avionics Division is under contract to the Rome Air Development Center (Contract Number F30602-80-C-0306) to evaluate and report on the possible cost/benefits of using commercial off-the-shelf equipment in place of military equipment in airborne inhabited fighter, airborne inhabited transport and fixed ground environments. A guideline will be included for implementation by Government Program Managers which will include recommendations whether commercial equipments can be effectively used in a given environment, with extra measures imposed to reduce risks. As a part of this contract, we have been requested to solicit inputs from industrial firms that have substantial background in both commercial and military electronics manufacturing to obtain opinions and viewpoints on at least the following questions:

a. Discuss the design difference in 1.) Good Commercial Practices, 2.) Best Commercial Practices, 3.) Ruggedized and, 4.) Militarized, all of which are commonly used equipment manufacturer's terms. The discussion may consider any of the following factors:

1. Thermal design
2. Derating practices
3. Part qualities
4. Packaging concepts
5. Shock and vibration limits
6. Temperature limits
7. Humidity limits
8. Quality assurance provisions

b. Briefly discuss, if applicable, your experiences in adapting commercial off-the-shelf equipment to a military environment.

c. Discuss benefits which you have or would expect to experience in using commercial off-the-shelf equipment in a military environment.

d. Discuss drawbacks which you have or would expect to experience in using commercial off-the-shelf equipment in a military environment.

We would appreciate your comments on these questions together with any related information or observations that you feel may be of benefit to our study. If possible, we would like to receive your comments by July 15, 1981 so that we may expand or clarify comments received. In addition to your textual response to the listed questions, we would appreciate your completing the attached form to supply background information about your company and to summarize your overall opinions in a way suited for easy tabulation.

Thank you for your assistance in this matter. Should further information be desired, please contact either Mr. Norbert Schmidt, (319) 395-4585 or Mr. Bruce Johnson, (319) 395-3485.

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
            M/S 108-275

COMPANY   A

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

Airborne Weather Radar   None   None

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER		X	
AIRBORNE INHABITED TRANSPORT	X		
FIXED GROUND		X	

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We have reviewed your request for data on the application of commercial avionics equipment to military aircraft. Enclosed is the completed four page questionaire contained in your letter.

Our experience in applying commercial avionics to military aircraft is in the area of weather radar and navigation equipment. In general, the application has worked very well. Equipment performance has measured up to expectations, reliability has been good, maintenance is below projections, and cost is far below equipment designed to military specifications and standards.

The two principal areas of concern in determining the applicability of commercial equipment are both environmental. The temperature ranges experienced in military equipment (particularly fighters) can often far exceed the normal environment of a commercial air transport aircraft. The shock and vibration environment may also be much more severe. Some improvement can be realized in both areas by substituting MIL qualified components for standard ones (at considerable expense), but MIL components don't always exist as a direct substitute for the selected commercial component. If redesigning is required, the unit is no longer considered a commercial item.

Some recent information on the application of a commercial weather radar in the Air Force's C-141 transport aircraft might be available in a report issued by the Military Aircraft Command. The report is identified below but is currently limited in distribution to U.S. Government agencies. Requests for information pertaining to the report must be referred to HQ MAC/XPQT, Scott AFB, IL 62225.

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	X	Shock and vibration requirements usually too severe for commercial equipment.
MAINTAINABILITY	X	☐	☐	Commercial equipment is usually designed for ease of maintenance.
AVAILABILITY	☐	X	☐	Depends on requirements.
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	☐	X	MIL-Standard parts not normally used.
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	X	☐	
SPECIAL HANDLING	X	☐	☐	Commercial equipment is designed for rapid LRU replacement.
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	☐	X	Equipment not designed for use in a combat environment.
NON-STANDARD POWER DEMANDS	X	☐	☐	Most equipment operates at 115 VAC 400 Hz or 28 VDC.
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	X	MIL-STD-454 requirements are much more severe than DO-160A.
SMALL BUSINESS OPPORTUNITY	☐	☐	X	Major systems are not currently produced by small business organizations.
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	Commercial equipment is well supported.
GUARANTEES AND WARRANTIES	X	☐	☐	RIW, RAW & LCC conditions have been applied to commercial equipment for military applications
GOVERNMENT DATA RIGHTS	☐	X	☐	Data is available but often considered proprietary.

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH
RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	X	☐	☐	Environment is same as commercial air transport. Proven results.
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	☐	X	☐	Low risk for existing systems.
PERSONNEL, SAFETY, TRAINING	X	☐	☐	Usually provided.
PART QUALITY LEVEL	☐	X	☐	Non MIL spec. parts generally used in design.
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	X	☐	
SPECIAL HANDLING	X	☐	☐	See page 2.
QUALITY ASSURANCE PROVISIONS	☐	X	☐	See page 2.
COMBAT READINESS	☐	X	☐	Transport combat environment is judged less severe then fighter environment.
NON-STANDARD POWER DEMANDS	X	☐	☐	See Page 2.
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	Equipment generally complies with DO-138 or DO-160.
SMALL BUSINESS OPPORTUNITY	☐	☐	X	See Page 2.
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	See Page 2.
GUARANTEES AND WARRANTIES	X	☐	☐	See Page 2.
GOVERNMENT DATA RIGHTS	☐	X	☐	See Page 2.

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4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
   EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED
   MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	☐	See Page 3. This is an exact replica of that form.
MAINTAINABILITY	☐	☐	☐	
AVAILABILITY	☐	☐	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	☐	
PART QUALITY LEVEL	☐	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	☐	
SPECIAL HANDLING	☐	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☐	☐	
COMBAT READINESS	☐	☐	☐	
NON-STANDARD POWER DEMANDS	☐	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☐	
GUARANTEES AND WARRANTIES	☐	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☐	

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
            M/S 108-275

COMPANY_____B_____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER :_____

PRINCIPAL PRODUCT LINE	COMMERCIAL	MILITARY
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	1	9	6
AIRBORNE INHABITED TRANSPORT	2	0	14
FIXED GROUND	11	1	5

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COMPANY B

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT
TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	1	4	11	
MAINTAINABILITY	6	3	7	
AVAILABILITY	8	6	2	
PERSONNEL, SAFETY, TRAINING	8	4	4	
PART QUALITY LEVEL	1	9	5	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	6	5	4	
SPECIAL HANDLING	6	5	4	
QUALITY ASSURANCE PROVISIONS	1	9	4	
COMBAT READINESS	2	5	8	
NON-STANDARD POWER DEMANDS	12	2	1	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	4	4	7	
SMALL BUSINESS OPPORTUNITY	8	2	2	
SPARES PROVISIONING, AVAILABILITY	8	3	5	
GUARANTEES AND WARRANTIES	7	2	5	
GOVERNMENT DATA RIGHTS	5	4	5	

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3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	2	14	1	
MAINTAINABILITY	8	5	4	
AVAILABILITY	9	7	1	
PERSONNEL, SAFETY, TRAINING	10	4	3	
PART QUALITY LEVEL	3	13	1	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	11	4	2	
SPECIAL HANDLING	6	10	1	
QUALITY ASSURANCE PROVISIONS	0	17	0	
COMBAT READINESS	2	13	2	
NON-STANDARD POWER DEMANDS	12	4	1	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	5	7	5	
SMALL BUSINESS OPPORTUNITY	7	2	2	
SPARES PROVISIONING, AVAILABILITY	8	3	3	
GUARANTEES AND WARRANTIES	7	5	3	
GOVERNMENT DATA RIGHTS	5	4	6	

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4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	8	7	0	
MAINTAINABILITY	9	5	1	
AVAILABILITY	8	7	0	
PERSONNEL, SAFETY, TRAINING	12	1	2	
PART QUALITY LEVEL	3	12	0	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	10	2	3	
SPECIAL HANDLING	11	4	0	
QUALITY ASSURANCE PROVISIONS	5	9	1	
COMBAT READINESS	7	8	0	
NON-STANDARD POWER DEMANDS	14	1	0	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	3	9	3	
SMALL BUSINESS OPPORTUNITY	7	3	3	
SPARES PROVISIONING, AVAILABILITY	6	3	7	
GUARANTEES AND WARRANTIES	8	5	2	
GOVERNMENT DATA RIGHTS	4	4	7	

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COMPANY C

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
            M/S 108-275

COMPANY____C_____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

                                                    80% 10% 10%
Radar (85%)   _____   AF/Army/Navy
_____   _____   _____

Radar/Communications (15%)   FAA (100%)   _____
_____   _____   _____

_____   _____   _____

_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER		X	
AIRBORNE INHABITED TRANSPORT			X
FIXED GROUND	X		

A1-12

COMPANY C

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT
TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	☒	
MAINTAINABILITY	☐	☐	☒	Very little BIT handling could be a problem.
AVAILABILITY	☐	☐	☒	
PERSONNEL, SAFETY, TRAINING	☒	☐	☐	
PART QUALITY LEVEL	☐	☐	☒	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	☒	
SPECIAL HANDLING	☐	☒	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	Benign 20 dynamic environ.
COMBAT READINESS	☐	☐	☒	
NON-STANDARD POWER DEMANDS	☐	☒	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☒	No shielding, A/C power, etc.
SMALL BUSINESS OPPORTUNITY	☒	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☒	☐	☐	
GUARANTEES AND WARRANTIES	☐	☐	☒	
GOVERNMENT DATA RIGHTS	☒	☐	☐	

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3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH
RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	Temp/vib. more closely controlled.
MAINTAINABILITY	☐	☐	X	No/little self test.
AVAILABILITY	☐	X	☐	
PERSONNEL, SAFETY, TRAINING	☐	X	☐	
PART QUALITY LEVEL	☐	X	☐	Not as critical as fighter.
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	X	☐	
SPECIAL HANDLING	☐	X	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	☐	X	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	X	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	☐	X	☐	
GOVERNMENT DATA RIGHTS	X	☐	☐	

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4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED
MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	☐	Same as Sheet 3.
MAINTAINABILITY	☐	☐	☐	
AVAILABILITY	☐	☐	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	☐	
PART QUALITY LEVEL	☐	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	☐	
SPECIAL HANDLING	☐	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☐	☐	
COMBAT READINESS	☐	☐	☐	
NON-STANDARD POWER DEMANDS	☐	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☐	
GUARANTEES AND WARRANTIES	☐	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☐	

A1-15

Attached for your information are various replies received from Field
Service & Support Division managers who have had extensive experience
supporting the use, repair, calibration and overhaul of commercial test
equipment in the military environment.

You will note they do not all agree; that is to be expected because
their experience has been associated with different supporting activities.

A more precise definition of potential applications for commercial test
equipment might result in significantly different opinions. For example,
the levels of maintenance (i.e., organizational, intermediate or depot)
would most likely be the dominant influence on suitability of commercial
test equipment as opposed to the type of system being supported.

A request was received to provide a materials and processes oriented response to the industry survey questionnaire from Collins Avionics Division of Rockwell International. The request came about because of a contract Rockwell has with Rome Air Development Center to evaluate the cost/benefits of using commercial off-the-shelf equipment in airborne and ground military hardware.

There are really two facets to the proposition of materials and processes for commercial equipment. The first is the materials and processes one would normally find in off-the-shelf commercial equipment such as a Lambda power supply or a Hewlitt-Packard frequency counter. The second facet is use of off-the-shelf commercial materials (or processes) in the contract design of military hardware. The risks, costs, and benefits of these two facets are separate considerations.

As a general rule, the materials and processes in commercial equipment do not meet the military requirements, or at least cannot be verified that they do, imposed on contracts. Examples would be the requirement to meet MIL-STD-454, Requirements 3, 5, 16, 23 etc. On the other hand, materials and processes used in this commercial equipment may perform the required mission with very minimal risk and problems since the equipment may not be subjected to the worst military environment. The obvious conclusion is that although contractual requirements are intended to cover any worst case situation, they often impose more complexity than is needed.

The experiences of this company in furnishing systems with some hardware of commercial origin, is that the materials and processes included therein are usually the same if the equipment is either ruggedized or militarized. Often, things like platings, paints, lubricants, printed wiring, welding, etc., in best commercial practice equipment is entirely adequate since it is frequently made for the severe industrial use market. Good commercial practice built equipment does pose a moderate risk since materials often chosen will not withstand common military use and environments for very long. This company has had to adapt off-the-shelf commercial equipment for military contracts, any required modifications are not hindered by the materials and processes; the problems come in verifying that all the myriad MIL-spec requirements in the contract "boiler-plate" are met.

The other facet of the question, using commercial materials for military hardware, is quite straightforward. Commercial off-the-shelf materials and processes are quite suitable and pose negligible risks or problems. This situation is because the industry that formulates and supplies raw materials for the most part does not have a special higher quality level line of products for the military market. Materials and processes for the military market (i.e.: platings, resins, high strength alloys, etc.) are characterized mainly by different marketing and quality record keeping. The products are not manufactured differently. Indeed, many key materials and processes used in military electronic systems are commercial items chosen by careful design practices and perform better than the alternate Mil-spec covered materials.

In order to enhance the effectiveness of using commercial off-the-shelf equipment, the military procurement activities should modify their practices slightly. Their current practice of requiring Mil-spec control of materials and processes from beginning to end should be supplemented by an additional method of allowing design analysis and test to show suitability of commercial equipment. In such a scheme, the design contractor's engineering task could include engineering documentation of the degree of suitability of a given piece of commercial equipment and any needed modifications to make it suitable for that specific military use.

An illustration of what this might entail is a chart recorder that has internal wires and components spot bonded for improved vibration resistance, openings sealed for moisture and dust protection, and fitted with a special plastic front cover to provide fungus resistance. It would not be possible to impose such actions on the manufacturer, but by documenting the as-supplied condition of the equipment and modifications needed, the government's primary concerns of reprocurement and maintainability could be assured. Approaches such as these and simplified documentation procedures for off-the-shelf materials and processes, would greatly facilitate fulfillment of design and development projects for military equipment.

(Comments not specifically applicable to a particular survey.)

In response to the referent, it appears that the detailed questions asked in the Industry Survey have already, by your distribution, been addressed to the activities in the best position to respond. Specifically these are the Product Design, Technology Support, Support Systems and Subcontract and Material Procurement activities.

RSG Contracts observations regarding the use of commercial, off-the-shelf equipment are somewhat more general in nature. They can best be summarized in two areas of applicability.

In airborne inhabited fighters, equipment specification requirements have generally precluded use of commercial equipment, although in at least one instance (the Sperry Disc Memory in the F-18 radar data processor) the development prior to contract of a strong technical position permitted its use. The equipment involved is best described as a ruggedized item (designed for air vehicle use) with some additional measures taken to ensure its suitability in its intended application.

In fixed ground (which includes transportable) applications, use of commercial, off-the-shelf equipment is an increasingly common practice, at least where equipment designed to best commercial practices is available. As with equipment intended for airborne inhabited fighters, however, it is almost mandatory to anticipate the potential applicability prior to issuance of a contract.

In all cases the most significant impediments to use of anything less than fully militarized equipment are contractually required specifications that do not adequately anticipate the potential applicability of such lesser specified equipment. Any revisions to acquisition policy designed to encourage use of commercial off-the-shelf equipment should recognize and remedy in an appropriate manner this existing contractual problem.

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
            M/S 108-275

COMPANY D, Division 1

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL PRODUCT LINE	COMMERCIAL	MILITARY
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	X	☐	☐
AIRBORNE INHABITED TRANSPORT	X	☐	☐
FIXED GROUND	X	☐	☐

A1-20

Following are several comments on the subject summary; attached are
the completed forms.

1. On the subject of design differences:

    ● Good commercial practice is design/manufacture to the
      level needed for general household/industrial use. I
      would say this level produces merchandise of varied
      quality and reliability based on random events rather
      than planning.

    ● Best commercial practice would be one grade higher;
      premium products having higher price tags with some
      improved quality, safety, operability, etc, some
      planning and control to assure a better mousetrap.
      This may also include more expensive packaging with
      lower level innards to allow a higher price for no
      more quality.

    ● Ruggedized products require some control for application
      in mobile environment, such as aircraft, boats, and
      automobiles. Ruggedizing may be applied to the install-
      ation problem, although we would also expect some concern
      for ruggedization of the inner workings of the device.

    ● Militarized products are designed to withstand the rigors
      of war and the military environment. However, somewhere
      along the way, the complexity of the equipment comprises
      the reliability and quality. The container may be the
      most serviceable part of the equipment; the working
      portion may have discontinued operating long before being
      subjected to the severe military environment.

2. I have no experience adapting off-the-shelf equipment to the military
    environment.

3. My observation of applications of commercial equipment to airlines,
    ships, and autos makes me believe we would have increased operational
    readiness at reduced cost. However, the commercial equipment is not
    war-tested and I do not know if it would hold-up as well or worse
    than the militarized equipment in use; chances are it would operate
    at least as well. The airlines subject their equipment to relatively
    severe environments and they seem to maintain their readiness with
    few major interruptions due to equipment failures.

4. I do not foresee any serious drawbacks using commercial equipment. Consideration should be given to and designed into the equipment for standardization, safety, packaging, and environmental limits. I don't believe, however, that all equipment have to be designed for operation from $-55^{\circ}C$ to $+71^{\circ}C$, a sure way to reduce cost. In the event a severe environment is expected, consideration might be given to controlling the environment within which the equipment is installed rather than redesigning the equipment.

COMPANY D

DIVISION 1

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A <u>MILITARY AIRBORNE INHABITED FIGHTER</u> ENVIRONMENT WITH RESPECT
TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	X	☐	☐	Redundancy for flight essential functions.
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	X	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	☐	☐	X	Assume aircraft modified and accept installation.
QUALITY ASSURANCE PROVISIONS	X	☐	☐	
COMBAT READINESS	X	☐	☐	I believe the airlines have a higher ready rate than military.
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	X	☐	☐	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	X	☐	☐	

COMPANY D

DIVISION 1

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH
RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	X	☐	☐	
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	X	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	X	☐	☐	
COMBAT READINESS	X	☐	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	X	☐	☐	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	X	☐	☐	

A1-24

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED
MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	X	☐	☐	
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	X	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	X	☐	☐	
COMBAT READINESS	X	☐	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	X	☐	☐	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	X	☐	☐	

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
M/S 108-275

COMPANY___D, Division 2_____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	☐	☒	☐
AIRBORNE INHABITED TRANSPORT	☐	☐	☒
FIXED GROUND	☐	☐	☒

My immediate reaction, based on extensive experience (sometimes painful)
is that use of commercial off-the-shelf equipment is high risk almost
across the board for reasons which are stated below.

While the initial cost would appear to be cheaper, this is deceptive from
the standpoint of usefullness of the equipment in military use.

Because usually there is no suitable specification to which the manufacturer
must adhere, there is degradation in operative capability caused by temperature,
humidity, shock and vibration, particularly during use in manned airborne
vehicles. The operational quality of equipment I have seen varies from
excellent to completely unsatisfactory. Some of the other disadvantages include:
no configuration management, i.e. the manufacturer is free to change parts
and operating characteristics at will; there are usually limited buys and
production runs and the manufacturer does not maintain a parts bank for
spares; the purchase agreement does not usually include such amenities as
provisioning, standardized technical data and training. The user is severely
hampered in attempting to maintain the equipment in an operational status.
The technical data is sparse at best with no information usually available
on trouble-shooting and in some cases even on calibration requirements. A
notable example is Hewlett Packard. They build excellent test equipment,
usually very reliable, but refuse to provide detailed technical information
under the guise of proprietorship and further refuse to do business directly
with the Government. The choice of several items of Hewlett Packard equipment
for use in the AWM-23 and the DSM-130 was dictated by the Government which
has left the Phoenix Program in bad shape some years later when the equipment
is out of production and parts cannot be identified. In addition, Hewlett
Packard will not provide assistance without an expensive service contract.

Other equipment, like radios, compasses and similar avionics are also high
risk for many of the reasons stated above.

In summary, quality and reliability are obtainable, but Maintainability is
severely hampered. The ruggedization/militarization/military spec. are worth
the extra cost in the long term.

COMPANY D

DIVISION 2

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	
MAINTAINABILITY	☐	☐	X	
AVAILABILITY	☐	X	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	X	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	X	
SPECIAL HANDLING	☐	☐	X	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	☐	X	
NON-STANDARD POWER DEMANDS	☐	X	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	X	
GUARANTEES AND WARRANTIES	☐	X	☐	
GOVERNMENT DATA RIGHTS	☐	☐	X	

A1-28

COMPANY D

DIVISION 2

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
   EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH
   RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☒	☐	
MAINTAINABILITY	☐	☐	☒	
AVAILABILITY	☐	☒	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	☒	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	☒	
SPECIAL HANDLING	☐	☐	☒	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☐	☐	☒	
NON-STANDARD POWER DEMANDS	☐	☒	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☒	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☒	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☒	
GUARANTEES AND WARRANTIES	☐	☒	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☒	

A1-29

COMPANY D

DIVISION 2

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☒	☐	
MAINTAINABILITY	☐	☒	☐	
AVAILABILITY	☐	☒	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	☒	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	☒	
SPECIAL HANDLING	☐	☒	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☐	☒	☐	
NON-STANDARD POWER DEMANDS	☐	☒	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☒	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☒	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☒	
GUARANTEES AND WARRANTIES	☐	☒	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☒	

A1-30

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
M/S 108-275

COMPANY___D. Division 3_____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL PRODUCT LINE	COMMERCIAL	MILITARY
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	[ ]	[X]	[ ]
AIRBORNE INHABITED TRANSPORT	[ ]	[ ]	[X]
FIXED GROUND	[X]	[ ]	[ ]

A1-31

COMPANY D

DIVISION 3

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT
TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY			X	
MAINTAINABILITY			X	
AVAILABILITY		X		
PERSONNEL, SAFETY, TRAINING	X			
PART QUALITY LEVEL		X		
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X			
SPECIAL HANDLING			X	
QUALITY ASSURANCE PROVISIONS		X		
COMBAT READINESS			X	
NON-STANDARD POWER DEMANDS	X			
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE			X	
SMALL BUSINESS OPPORTUNITY				
SPARES PROVISIONING, AVAILABILITY			X	
GUARANTEES AND WARRANTIES				
GOVERNMENT DATA RIGHTS				

A1-32

COMPANY D

DIVISION 3

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH
RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☒	☐	
MAINTAINABILITY	☐	☒	☐	
AVAILABILITY	☐	☒	☐	
PERSONNEL, SAFETY, TRAINING	☒	☐	☐	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☒	☐	☐	
SPECIAL HANDLING	☐	☒	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☐	☒	☐	
NON-STANDARD POWER DEMANDS	☒	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☒	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☒	☐	
GUARANTEES AND WARRANTIES	☐	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☐	

A1-33

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☒	☐	
MAINTAINABILITY	☒	☐	☐	
AVAILABILITY	☒	☐	☐	
PERSONNEL, SAFETY, TRAINING	☒	☐	☐	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☒	☐	☐	
SPECIAL HANDLING	☒	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☒	☐	☐	
NON-STANDARD POWER DEMANDS	☒	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☒	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☒	
GUARANTEES AND WARRANTIES	☐	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☐	

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
M/S 108-275

COMPANY____D. Division 4_____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER :_____

PRINCIPAL PRODUCT LINE	COMMERCIAL	MILITARY
Radars, Missiles & Test Equipment		

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
   MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER		X	
AIRBORNE INHABITED TRANSPORT			X
FIXED GROUND	X		

A1-35

This company has had considerable experience using commercial grade Test
equipment in various military ground and shipboard environments. I am
not aware of any of this company's airborne systems which have used commercial
equipment.

The commercial test equipment has been found to be suitable in the AWM-23
in both shore-based and shipboard applications. The major problem has
been a lack of support on the part of the U.S. Navy. There has been a
shortfall in practically every element of support for CTE. This includes
training, spares provisioning, and technical pubs for calibration/repair.
If the CTE was given adequate logistic support it would be entirely suitable
for most fixed ground environments.

COMPANY D

DIVISION 4

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
   EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT
   TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	☐	This page not applicable.
MAINTAINABILITY	☐	☐	☐	
AVAILABILITY	☐	☐	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	☐	
PART QUALITY LEVEL	☐	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	☐	
SPECIAL HANDLING	☐	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☐	☐	
COMBAT READINESS	☐	☐	☐	
NON-STANDARD POWER DEMANDS	☐	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☐	
GUARANTEES AND WARRANTIES	☐	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☐	

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	
MAINTAINABILITY	☐	X	☐	
AVAILABILITY	☐	X	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	☐	X	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	☐	X	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	X	
SMALL BUSINESS OPPORTUNITY	☐	X	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	X	
GUARANTEES AND WARRANTIES	☐	X	☐	
GOVERNMENT DATA RIGHTS	☐	☐	X	

A1-38

COMPANY D

DIVISION 4

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED
MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	X	☐	☐	
MAINTAINABILITY	☐	X	☐	
AVAILABILITY	☐	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	☐	X	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	X	☐	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	X	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	X	Lack of configuration control in out-years.
GUARANTEES AND WARRANTIES	☐	X	☐	
GOVERNMENT DATA RIGHTS	☐	☐	X	

41-39

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
                 COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
                 EQUIPMENT

                 <u>RETURN TO:</u>

                 COLLINS AVIONICS GROUP
                 400 COLLINS ROAD, N.E.
                 CEDAR RAPIDS, IOWA 52406
                 ATTENTION: MR. BRUCE JOHNSON
                             M/S 108-275

COMPANY D, Division 5

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL PRODUCT LINE	COMMERCIAL	MILITARY
Air to Air, Air to Ground	None	All Sources
Missiles		

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
   MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	☐	☐	X
AIRBORNE INHABITED TRANSPORT	☐	☐	X
FIXED GROUND	X	☐	☐

The Collins Avionic Survey on cost/benefits of using "off-the-shelf" commercial equipment should be answered primarily by TSD. The usage of this type of equipment as seen from the FSO standpoint is after the commercial equipment is selected and specific acceptance and design requirements are established by either Standard Drawings (900 000 specs) or specification/source control drawings. TSD can better determine if commercial equipment is usable without controls being established. The terms cited: good or best commercial practice, militarized or ruggedized, is not defined and if used would require specific definition or development of industry standards.

It is recommended that FSO defer to the design activities for comments.

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☒	☐	
MAINTAINABILITY	☐	☐	☒	
AVAILABILITY	☐	☒	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	☒	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☒	☐	☐	
SPECIAL HANDLING	☒	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☐	☒	☐	
NON-STANDARD POWER DEMANDS	☒	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☒	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☒	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☒	
GUARANTEES AND WARRANTIES	☒	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☒	

COMPANY D

DIVISION 5

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH
RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	
MAINTAINABILITY	☐	☐	X	Data availability.
AVAILABILITY	☐	X	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	X	Data availability.
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	X	

A1-43

COMPANY D

DIVISION 5

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
   EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED
   MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	
MAINTAINABILITY	☐	☐	X	Data availability.
AVAILABILITY	☐	X	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	X	Data availability.
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	X	☐	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY	☐	X	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	X	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	X	

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
            M/S 108-275

COMPANY   D, Division 6 _____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER		X	
AIRBORNE INHABITED TRANSPORT			X
FIXED GROUND	X		

A1-45

COMPANY D

DIVISION 6

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT
TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	X	
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	X	☐	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☐	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	X	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	☐	X	☐	
GOVERNMENT DATA RIGHTS	☐	☐	X	

A1-46

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH
RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	X	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	☐	X	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	☐	X	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	☐	X	☐	
GOVERNMENT DATA RIGHTS	☐	☐	X	

COMPANY D

DIVISION 6

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED
MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	X	☐	☐	
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	X	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	X	☐	☐	
COMBAT READINESS	X	☐	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	☐	X	☐	
GOVERNMENT DATA RIGHTS	☐	☐	X	

A1-48

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
            M/S 108-275

COMPANY D, Division 7 _____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

_____   _____   _____
_____   _____   _____
_____   _____   _____
_____   _____   _____
_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	☐	☐	X
AIRBORNE INHABITED TRANSPORT	☐	☐	X
FIXED GROUND	X	☐	☐

A1-49

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY			X	
MAINTAINABILITY			X	
AVAILABILITY			X	
PERSONNEL, SAFETY, TRAINING		X		
PART QUALITY LEVEL			X	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT		X		
SPECIAL HANDLING		X		
QUALITY ASSURANCE PROVISIONS			X	
COMBAT READINESS			X	
NON-STANDARD POWER DEMANDS	X			
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE			X	
SMALL BUSINESS OPPORTUNITY		X		
SPARES PROVISIONING, AVAILABILITY			X	
GUARANTEES AND WARRANTIES			X	
GOVERNMENT DATA RIGHTS	X			

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
   EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH
   RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	☒	
MAINTAINABILITY	☐	☐	☒	
AVAILABILITY	☐	☐	☒	
PERSONNEL, SAFETY, TRAINING	☐	☒	☐	
PART QUALITY LEVEL	☐	☐	☒	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☒	☐	
SPECIAL HANDLING	☐	☒	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☐	☐	☒	
NON-STANDARD POWER DEMANDS	☒	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☒	
SMALL BUSINESS OPPORTUNITY	☐	☒	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☒	
GUARANTEES AND WARRANTIES	☐	☐	☒	
GOVERNMENT DATA RIGHTS	☒	☐	☐	

COMPANY D

DIVISION 7

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	
MAINTAINABILITY	☐	X	☐	
AVAILABILITY	☐	X	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY	☐	X	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	X	
GUARANTEES AND WARRANTIES	☐	X	☐	
GOVERNMENT DATA RIGHTS	X	☐	☐	

A1-52

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
                    COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
                    EQUIPMENT

                    RETURN TO:

                    COLLINS AVIONICS GROUP
                    400 COLLINS ROAD, N.E.
                    CEDAR RAPIDS, IOWA 52406
                    ATTENTION: MR. BRUCE JOHNSON
                                M/S 108-275

COMPANY   D, Division 8 _____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	☐	☐	☐
AIRBORNE INHABITED TRANSPORT	☐	☐	☐
FIXED GROUND	☐	☐	☐

A1-53

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT
TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	X	Obvious
MAINTAINABILITY	☐	☐	X	Obvious
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	X	Obvious
PART QUALITY LEVEL	☐	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	☐	
SPECIAL HANDLING	☐	☐	☐	Not much applicability in the commercial world.
QUALITY ASSURANCE PROVISIONS	☐	☐	☐	
COMBAT READINESS	☐	☐	☐	
NON-STANDARD POWER DEMANDS	☐	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☐	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	☐	☐	☐	Can be had for a price
GOVERNMENT DATA RIGHTS	☐	☐	☐	for commercial equipment?

A1-54

COMPANY D

DIVISION 8

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH
RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	☐	Essentially the same as
MAINTAINABILITY	☐	☐	☐	Page 2.
AVAILABILITY	☐	☐	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	☐	
PART QUALITY LEVEL	☐	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	☐	
SPECIAL HANDLING	☐	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☐	☐	
COMBAT READINESS	☐	☐	☐	
NON-STANDARD POWER DEMANDS	☐	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☐	
GUARANTEES AND WARRANTIES	☐	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☐	

A1-55

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
   EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED
   MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	☐	
MAINTAINABILITY	☐	☐	☐	
AVAILABILITY	☐	☐	☐	Alot of commercial equipment is already used in fixed ground environment, and much more could be used.
PERSONNEL, SAFETY, TRAINING	☐	☐	☐	
PART QUALITY LEVEL	☐	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	☐	Some commmercial equipment is better than military equipment. Good examples are voice communications and video transmitters and receivers.
SPECIAL HANDLING	☐	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☐	☐	
COMBAT READINESS	☐	☐	☐	
NON-STANDARD POWER DEMANDS	☐	☐	☐	Alot of commercial equipment is suitable for trainers and simulators.
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	The best bargains in test equipment are commercial.
SPARES PROVISIONING, AVAILABILITY	☐	☐	☐	
GUARANTEES AND WARRANTIES	☐	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☐	

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
M/S 108-275

COMPANY __D, Division 9_____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER			X
AIRBORNE INHABITED TRANSPORT			X
FIXED GROUND	X		

A1-57

COMPANY D

DIVISION 9

Based on experience of the Material staff and discussions with manufacturers, distributors, and vendors with which we do business, the following comments regarding use of commercial off-the-shelf equipment are submitted.

1. The end use application of the item in question is a critical factor in the consideration of need for control over the exact characteristics, reliability and dependability of the item. Military specifications do not make a reliable item. They only provide the specifications to which an item is supposed to be manufactured or built, and they provide Government control over the item. Commercial items may be as dependable, reliable and durable as any Mil Spec item, or more. Assuming equivalent quality assurance for both, from a performance standpoint, the major difference in specifying commercial or Mil Spec items boils down to the technical task of determining that the specifications for the item, including QA, meet the requirement of the application. The job is minimized for the buyer (Government when a Mil Spec can be specified). It becomes much more extensive and expensive in terms of manpower (for the buyer) when the buyer (Government) must make a separate determination for each application and across a range of vendors as to the acceptability of several commercial items. Further, control is lost, or may be lost, on specification stability for follow-up buys after an initial determination has been made. Then another determination of acceptability may be necessary for each subsequent acquisition. The Mil Spec obviates this necessity, albeit at generally higher acquisition cost, in most cases.

2. In applications of lesser criticality, e.g., ground support, adminstrative and other such applications, a trade-off of perhaps higher risk (at least some higher degree of uncertainty about the risk) for the lesser cost and higher availability of commercial off-the-shelf items certainly seems in order. In general, those are the advantages to be expected: Generally lower cost for the item itself; in general, a wider range of sources for the requirements, most assuredly to include more small businesses; and the resultant greater degree of short-term availability.

3. It is doubtful that the Government will ever be able to afford the manpower necessary to insure that the requirements of critical applications are met from commercial off-the-shelf items. Further, it is doubtful that the responsibilty for that assurace can be delegated through contracts with private industry. Moreover, the need for safeguarding information concerning military combat vehicles dictates against use of commonly available equipment. Thus, the continuation of military specifications and standards for critical military combat applications seems unavoidable. A program to accept commercial off-the-shelf items for less critical military applications however, seems very desirable from a cost, support effectiveness and operational viewpoint.

4. A copy of the Collins questionnaire with some positions reflected is attached.

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	☒	
MAINTAINABILITY	☐	☒	☐	
AVAILABILITY	☐	☒	☐	
PERSONNEL, SAFETY, TRAINING	☐	☒	☐	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☒	☐	
SPECIAL HANDLING	☐	☐	☒	
QUALITY ASSURANCE PROVISIONS	☐	☐	☒	
COMBAT READINESS	☐	☒	☐	
NON-STANDARD POWER DEMANDS	☒	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☒	
SMALL BUSINESS OPPORTUNITY	☐	☐	☒	
SPARES PROVISIONING, AVAILABILITY	☐	☒	☐	
GUARANTEES AND WARRANTIES	☐	☐	☒	
GOVERNMENT DATA RIGHTS	☐	☐	☒	

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH
RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	
MAINTAINABILITY	☐	X	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	☐	X	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	☐	X	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY	☐	X	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	☐	X	☐	
GOVERNMENT DATA RIGHTS	☐	☐	X	

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☒	☐	
MAINTAINABILITY	☒	☐	☐	
AVAILABILITY	☒	☐	☐	
PERSONNEL, SAFETY, TRAINING	☒	☐	☐	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☒	☐	☐	
SPECIAL HANDLING	☒	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☐	☒	☐	
NON-STANDARD POWER DEMANDS	☒	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☒	
SMALL BUSINESS OPPORTUNITY	☐	☒	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☒	☐	
GUARANTEES AND WARRANTIES	☐	☒	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☒	

A1-61

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
                  COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
                  EQUIPMENT

                  RETURN TO:

                  COLLINS AVIONICS GROUP
                  400 COLLINS ROAD, N.E.
                  CEDAR RAPIDS, IOWA 52406
                  ATTENTION: MR. BRUCE JOHNSON
                              M/S 108-275

COMPANY____D, Division 10_____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	[ ]	[ ]	[X]
AIRBORNE INHABITED TRANSPORT	[ ]	[ ]	[X]
FIXED GROUND	[ ]	[ ]	[X]

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY		X		*The principal problem encountered in using commercial parts in military applications is in the interface between drawing requirements, procurement requirements and, ultimately, provisioning. The military contractor's procurement system is based on standardized part numbers. The drawing system does not handle multiple part numbers with any efficiency. The resulting provisioning documentation can become a nightmare. Commercial suppliers are unlikely to develop an industry standard for numbering. Lacking that, the massive drawing/procurement/ILS system of the military must be dramatically changed if commercial parts are to be used. Considerations such as reliability are miniscule compared to the baroque controls that are required to bring a commercial part into a MIL-grade procurement system.
MAINTAINABILITY	X			
AVAILABILITY		X		
PERSONNEL, SAFETY, TRAINING		X		
PART QUALITY LEVEL		X		
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT			X	
SPECIAL HANDLING	X			
QUALITY ASSURANCE PROVISIONS		X		
COMBAT READINESS		X		
NON-STANDARD POWER DEMANDS	X			
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE		X		
SMALL BUSINESS OPPORTUNITY ?				
SPARES PROVISIONING, AVAILABILITY			*	
GUARANTEES AND WARRANTIES			X	
GOVERNMENT DATA RIGHTS			X	

A1-63

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS

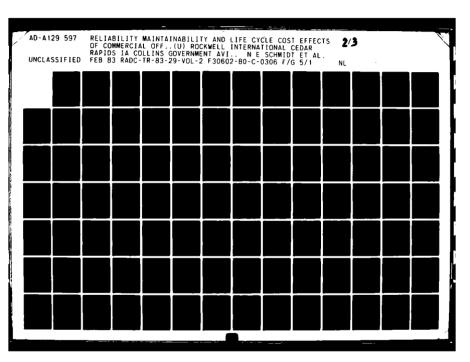| MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	*The principal problem encountered in using commercial parts in military applications is in the interface between drawing requirements, procurement requirements and, ultimately, provisioning. The military contractor's procurement system is based on standardized part numbers. The drawing system does not handle multiple part numbers with any efficiency. The resulting provisioning documentation can become a nightmare. Commercial suppliers are unlikely to develop an industry standard for numbering. Lacking that, the massive drawing/procurement/ILS system of the military must be dramatically changed if commercial parts are to be used. Considerations such as reliability are miniscule compared to the baroque controls that are required to bring a commercial part into a MIL-grade procurement system.
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	☐	X	☐	
PERSONNEL, SAFETY, TRAINING	☐	X	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	X	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY ?	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	*	
GUARANTEES AND WARRANTIES	☐	☐	X	
GOVERNMENT DATA RIGHTS	☐	☐	X	

A1-64

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
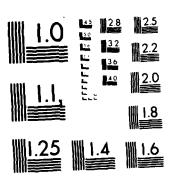COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
M/S 108-275

COMPANY   D, Division 11

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER: _____

PRINCIPAL PRODUCT LINE	COMMERCIAL	MILITARY
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	☐	☐	☐
AIRBORNE INHABITED TRANSPORT	☐	☐	☐
FIXED GROUND	X	☐	X

A1-65

COMPANY D

DIVISION 11

If we are permitted used of Commercial Off-the-Shelf equipment it is obvious that
the opportunity for dealing with small business firms will be greatly expanded,
and lead times for spares will be significantly reduced. It does not appear
that our warranty obligations will be significantly affected. There should be
no affect on Government Data Rights except that there may be a reduction in re-
quests for limited rights data since procurement would probably be more straight
forward and less complex; however, this is not of significance.

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	☐	
MAINTAINABILITY	☐	☐	☐	
AVAILABILITY	☐	☐	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	☐	
PART QUALITY LEVEL	☐	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	☐	
SPECIAL HANDLING	☐	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☐	☐	
COMBAT READINESS	☐	☐	☐	
NON-STANDARD POWER DEMANDS	☐	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☐	
SMALL BUSINESS OPPORTUNITY	☒	☐	☐	Greatly expanded opportunity
SPARES PROVISIONING, AVAILABILITY	☒	☐	☐	Less lead times, much greater availability
GUARANTEES AND WARRANTIES	☒	☐	☐	Not significantly affected
GOVERNMENT DATA RIGHTS	☒	☐	☐	No affect. If anything, a reduction in requests for limited rights.

A1-67

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED
MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	*The principal problem encountered in using commercial parts in military applications is in the interface between drawing requirements, procurement requirements and, ultimately, provisioning. The military contractor's procurement system is based on standardized part numbers. The drawing system does not handle multiple part numbers with any efficiency. The resulting provisioning documentation can become a nightmare. Commercial suppliers are unlikely to develop an industry standard for numbering. Lacking that, the massive drawing/procurement/ILS system of the military must be dramatically changed if commercial parts are to be used. Considerations such as reliability are miniscule compared to baroque controls that are required to bring a commercial part into a MIL-grade procurement system.
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	☐	X	☐	
PERSONNEL, SAFETY, TRAINING	☐	X	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	X	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY ?	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	*	
GUARANTEES AND WARRANTIES	☐	☐	X	
GOVERNMENT DATA RIGHTS	☐	☐	X	

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406.
ATTENTION: MR. BRUCE JOHNSON
            M/S 108-275

COMPANY___D, Division 12_____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER		X	
AIRBORNE INHABITED TRANSPORT			X
FIXED GROUND	X		

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	☒	
MAINTAINABILITY	☐	☒	☐	
AVAILABILITY	☒	☐	☐	
PERSONNEL, SAFETY, TRAINING	☒	☐	☐	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☒	☐	☐	
SPECIAL HANDLING	☒	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☐	☒	☐	
NON-STANDARD POWER DEMANDS	☒	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☒	☐	☐	
SMALL BUSINESS OPPORTUNITY	☒	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☒	☐	☐	
GUARANTEES AND WARRANTIES	☒	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☒	☐	

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	
MAINTAINABILITY	☐	X	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	X	☐	☐	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	☐	X	☐	

A1-71

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	X	☐	☐	
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	X	☐	☐	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	☐	X	☐	

COMPANY D

DIVISION 13

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
M/S 108-275

COMPANY _____ D, Division 13 _____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER: _____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	☐	☐	☒ X
AIRBORNE INHABITED TRANSPORT	☐	☐	☒ X
FIXED GROUND	☒ X	☐	☐

A1-73

Commercial environment in many cases are no less severe than military. For example, the temperature under the hood of a car exceeds the temperature limits of the inhabited portion of an aircraft.

FAA qualified equipment may exceed mil-spec in some cases.

Commercial piece parts can and have been used in military equipments - their quality level proven either by piece part burn-in and test or by burn-in at the assembly level.

Knowledge of commercial product design is very limited, but feel that good or best commercial quality equipment could be qualified to a reasonable mil environment.

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT
TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	X	
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	☐	X	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	☐	X	☐	
QUALITY ASSURANCE PROVISIONS	☐	☐	X	
COMBAT READINESS	☐	☐	X	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	X	☐	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☐	
GUARANTEES AND WARRANTIES	☐	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☐	

A1-75

COMPANY D
DIVISION 13

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH
RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	☐	X	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	X	☐	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☐	
GUARANTEES AND WARRANTIES	☐	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☐	

A1-76

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☒	☐	
MAINTAINABILITY	☒	☐	☐	
AVAILABILITY	☒	☐	☐	
PERSONNEL, SAFETY, TRAINING	☒	☐	☐	
PART QUALITY LEVEL	☒	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☒	☐	☐	
SPECIAL HANDLING	☐	☒	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☐	☒	☐	
NON-STANDARD POWER DEMANDS	☒	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☒	☐	☐	
SMALL BUSINESS OPPORTUNITY	☐	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☐	☐	
GUARANTEES AND WARRANTIES	☐	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	☐	

A1-77

COMPANY D

DIVISION 14

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
            M/S 108-275

COMPANY ____ D, Division 14 _____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER: _____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

_____   _____   _____
_____   _____   _____
_____   _____   _____
_____   _____   _____
_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
   MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	☐	☐	☐
AIRBORNE INHABITED TRANSPORT	☐	☐	☐
FIXED GROUND	X	☐	X

Military fixed ground equipment can meet design objectives utilizing commercial off-the-shelf equipments. Most CTE vendors are reluctant to alter their product lines for the added requirements of the military applications. To reduce "high risk" areas the contract gives should relax specification which drive the life cycle costs. High risk areas which could be reduced are non-standard parts T & W , etc., and guaratees and warranties. If the Government or some agency would review CTE and establish a preferred list for design selection of non-standard parts, tools, logistics, etc., could be reduced. If the selected items were then used "unaltered" by the user. The CTE vendor warranties

COMPANY D
DIVISION 14

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	X			Using enclosed select to provide favorable environment.
MAINTAINABILITY		X		Varies with vendor; some good, some bad.
AVAILABILITY		X		Vendor can discontinue a given model or product line.
PERSONNEL, SAFETY, TRAINING	X			Mainly a user problem; not the vendor.
PART QUALITY LEVEL		X		Commercial equipment uses penny saving parts.
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT			X	Inventory could be larger.
SPECIAL HANDLING		X		Difficult to asses.
QUALITY ASSURANCE PROVISIONS			X	Varies.
COMBAT READINESS	X			Cannot answer
NON-STANDARD POWER DEMANDS	X			Many CTE are designed with CONUS European power options
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE		X		Federal regulations are beginning to minimum requirements.
SMALL BUSINESS OPPORTUNITY			X	Must sell "as is" or will lose shirt.
SPARES PROVISIONING, AVAILABILITY			X	Prone to being discontinued by vendor
GUARANTEES AND WARRANTIES			X	If modified by user, vendor warranty null and void
GOVERNMENT DATA RIGHTS			X	Vendors reluctant to provide manufacturing data.

A1-80

COMPANY D
DIVISION 15

INDUSTRY SURVEY: RELIABILITY, MAINTAINABILITY AND LIFE CYCLE
COST EFFECT OF USING COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
M/S 108-275

COMPANY D, Division 15 _____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

_____   _____   _____
_____   _____   _____
_____   _____   _____
_____   _____   _____
_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER		X	
AIRBORNE INHABITED TRANSPORT			X
FIXED GROUND			X

A1-81

BASIS FOR RESPONSE

The attached inputs were prepared by several of the more experienced test equipment engineers in the Depot Support Systems Engineering (DSSE) organization; each with 20 or more years experience in the use of test equipment for military applications: The DSSE organization has been one of the primary suppliers of field and depot test equipment in support of the company's products for all branches of the service. The test equipment provided by DSSE has been primarily specialized equipment developed to military specifications. Some of the more recent equipment for shop use includes high quality commercial equipment from suppliers such as Hewlett Packard, Tektronix, and Fluke.

SUMMARY OF COMMENTS

1. Characteristics of Military Test Equipment

    a. Procured to specification.
    b. Standard performance requirements established for reliability, parts and components, EMI, and other parameters.
    c. Normally supported by technical manuals and complement of spare parts.
    d. Configuration control maintained throughout operating life.

2. Characteristics of Commercial Equipment

    a. Develop to broad generalized applications.
    b. Documentation is generally concise.
    c. Spare parts information is often hard to obtain.
    d. Configuration control is generally not maintained.
    e. Spare parts may go out of production during equipment operating life.

3. Airborne fighters experience temperature extremes, shock and vibration levels, and other environmental characteristics not normally faced by ground equipment. Therefore, commercial equipment, if used in flight, must be carefully selected, particularly for critical applications.

4. Transport aircraft can accommodate equipment in the fuselage bays and racks. The experienced environmental conditions are comparable with high quality commercial equipment.

5. Ground equipment must be selected on the basis of its intended use. Flight line equipment not protected from the temperature extremes and environmental elements require ruggedized features and functional design parts not normally available in commercial equipment. Units intended for shop and depot use may function very well with commercial quality components. However, replacement parts may be a problem.

COMPANY D

DIVISION 15

GENERAL COMMENTS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	X	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	X	☐	
SPECIAL HANDLING	☐	X	☐	
QUALITY ASSURANCE PROVISIONS	X	☐	☐	
COMBAT READINESS	☐	☐	☐	
NON-STANDARD POWER DEMANDS	☐	X	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	X	
SMALL BUSINESS OPPORTUNITY	☐	☐	X	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☐	X	

A1-83

COMPANY D

DIVISION 15

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
    EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT
    TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	☒	
MAINTAINABILITY	☐	☐	☒	
AVAILABILITY	☒	☐	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	☒	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☒	☐	
SPECIAL HANDLING	☐	☒	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☐	☐	☒	
NON-STANDARD POWER DEMANDS	☐	☐	☒	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☒	
SMALL BUSINESS OPPORTUNITY	☒	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☒	☐	Long term problem.
GUARANTEES AND WARRANTIES	☐	☐	☒	
GOVERNMENT DATA RIGHTS	☐	☒	☐	

A1-84

COMPANY D

DIVISION 15

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☒	☐	
MAINTAINABILITY	☐	☒	☐	
AVAILABILITY	☒	☐	☐	
PERSONNEL, SAFETY, TRAINING	☐	☐	☒	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☒	☐	
SPECIAL HANDLING	☐	☒	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☐	☒	☐	
NON-STANDARD POWER DEMANDS	☐	☐	☒	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☐	☒	
SMALL BUSINESS OPPORTUNITY	☒	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☒	☐	Long term problem.
GUARANTEES AND WARRANTIES	☐	☐	☒	
GOVERNMENT DATA RIGHTS	☐	☒	☐	

A1-85

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
   EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED
   MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☒	☐	
MAINTAINABILITY	☐	☒	☐	
AVAILABILITY	☒	☐	☐	
PERSONNEL, SAFETY, TRAINING	☒	☐	☐	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☒	☐	
SPECIAL HANDLING	☒	☐	☐	
QUALITY ASSURANCE PROVISIONS	☒	☐	☐	
COMBAT READINESS	☐	☒	☐	
NON-STANDARD POWER DEMANDS	☒	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	☒	☐	
SMALL BUSINESS OPPORTUNITY	☒	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☒	☐	Long term problem.
GUARANTEES AND WARRANTIES	☒	☐	☐	
GOVERNMENT DATA RIGHTS	☐	☒	☐	

A1-86

COMPANY D
DIVISION 16

INDUSTRY SURVEY: RELIABILITY, MAINTAI.3ILITY AND LIFE CYCLE
COST EFFECT OF USINC COMMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
            M/S 108-275

COMPANY _____ D, Division 16 _____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL
PRODUCT LINE   COMMERCIAL   MILITARY

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
    MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	[ ]	[X]	[ ]
AIRBORNE INHABITED TRANSPORT	[ ]	[ ]	[X]
FIXED GROUND	[X]	[ ]	[ ]

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☐	X	
MAINTAINABILITY	☐	X	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	☐	X	☐	
PART QUALITY LEVEL	☐	☐	X	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☐	☐	X	
SPECIAL HANDLING	☐	X	☐	
QUALITY ASSURANCE PROVISIONS	☐	☐	X	
COMBAT READINESS	☐	☐	X	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	☐	X	☐	

A1-88

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	☐	X	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	☐	X	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	☐	X	☐	

A1-89

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED
MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	X	☐	☐	
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	X	☐	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	☐	X	☐	
QUALITY ASSURANCE PROVISIONS	X	☐	☐	
COMBAT READINESS	X	☐	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☐	X	☐	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	X	☐	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	☐	X	☐	

A1-90

INDUSTRY SURVEY: RELIABILITY, MAINTAINA ILITY AND LIFE CYCLE
COST EFFECT OF USING C MMERCIAL OFF-THE-SHELF
EQUIPMENT

RETURN TO:

COLLINS AVIONICS GROUP
400 COLLINS ROAD, N.E.
CEDAR RAPIDS, IOWA 52406
ATTENTION: MR. BRUCE JOHNSON
            M/S 108-275

COMPANY____E_____

ADDRESS _____ ZIP CODE _____

CONTACT _____ PHONE NUMBER:_____

PRINCIPAL PRODUCT LINE	COMMERCIAL	MILITARY
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

1. ORGANIZATIONS GENERAL VIEW OF COMMERCIAL OFF-THE-SHELF EQUIPMENT USED IN
   MILITARY APPLICATIONS.

	APPLICABLE	NOT APPLICABLE	APPLICABLE WITH EXTRA MEASURES
AIRBORNE INHABITED FIGHTER	☐	☐	X
AIRBORNE INHABITED TRANSPORT	☐	☐	X
FIXED GROUND	☐	☐	X

COMPANY E

2. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF
EQUIPMENT IN A MILITARY AIRBORNE INHABITED FIGHTER ENVIRONMENT WITH RESPECT
TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	☒	☐	AFTER LIMITED SCREENING OF THERMAL SHOCK AND BURN-IN, COMMERCIAL PARTS SHOW SAME FAILURE RATES AS MIL-SPEC SCREENED PARTS, WHILE OPERATING IN SYSTEMS.
MAINTAINABILITY	☒	☐	☐	
AVAILABILITY	☒	☐	☐	
PERSONNEL, SAFETY, TRAINING	☒	☐	☐	
PART QUALITY LEVEL	☐	☒	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	☒	☐	☐	
SPECIAL HANDLING	☒	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	☒	☐	
COMBAT READINESS	☒	☐	☐	
NON-STANDARD POWER DEMANDS	☒	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	☒	☐	☐	
SMALL BUSINESS OPPORTUNITY	☒	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	☒	☐	
GUARANTEES AND WARRANTIES	☒	☐	☐	
GOVERNMENT DATA RIGHTS	☒	☐	☐	

A1-92

3. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY AIRBORNE INHABITED TRANSPORT ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	☐	X	☐	AFTER LIMITED SCREENING OF THERMAL SHOCK AND BURN-IN, COMMERCIAL PARTS SHOW SAME FAILURE RATES AS MIL-SPEC SCREENED PARTS, WHILE OPERATING IN SYSTEMS.
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	X	☐	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	X	☐	☐	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	X	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	X	☐	☐	

A1-93

4. ORGANIZATIONS VIEW OF RISK INVOLVED IN THE USE OF COMMERCIAL OFF-THE-SHELF EQUIPMENT IN A MILITARY GROUND FIXED ENVIRONMENT WITH RESPECT TO THE LISTED MAJOR FACTORS.

MAJOR FACTORS	LOW RISK	MODERATE RISK	HIGH RISK	COMMENTS
RELIABILITY	X	☐	☐	AFTER LIMITED SCREENING OF THERMAL SHOCK AND BURN-IN, COMMERCIAL PARTS SHOW SAME FAILURE RATES AS MIL-SPEC SCREENED PARTS, WHILE OPERATING IN SYSTEMS.
MAINTAINABILITY	X	☐	☐	
AVAILABILITY	X	☐	☐	
PERSONNEL, SAFETY, TRAINING	X	☐	☐	
PART QUALITY LEVEL	☐	X	☐	
NON-STANDARD PARTS, TOOLS, MATERIALS, PROCESSES, TEST EQUIPMENT	X	☐	☐	
SPECIAL HANDLING	X	☐	☐	
QUALITY ASSURANCE PROVISIONS	☐	X	☐	
COMBAT READINESS	X	☐	☐	
NON-STANDARD POWER DEMANDS	X	☐	☐	
ELECTROMAGNETIC COMPATIBILITY, INTERFERENCE	X	☐	☐	
SMALL BUSINESS OPPORTUNITY	X	☐	☐	
SPARES PROVISIONING, AVAILABILITY	☐	X	☐	
GUARANTEES AND WARRANTIES	X	☐	☐	
GOVERNMENT DATA RIGHTS	X	☐	☐	

A1-94

APPENDIX 2

LIFE CYCLE COST MODEL COMPUTER LISTING

A2.0   INTRODUCTION

This Appendix contains a complete listing of the program LCC, Version 2

life cycle cost model dated April 1976 as implemented on a UNIVAC

1100/81 computes for use on the Reliability, Maintainability and Life

Cycle Cost Effects of Using Commercial Off-The-Shelf Equipment study

contract.   This LCC program was developed by the Analytic Sciences

Corporation for the Aeronautical Systems Division (AFSC), USAF under

contract number F33657-75-C-0674.

```
1.  C FIRST SECTION OF TASC LCC MODEL 1/25/80
2.  C 7/25/79 VERSION REVISED 1/25/80 - INCREASED MAX NRU 50 TO 500
3.  C 6/04/79 VERSION REVISED 7/25/79 - LCC-2A VERSION FROM DRC
4.  C 5/30/79 VERSION REVISED 6/4/79 -INCREASED MAX SE FROM 10 TO 40
5.  C 12/8/78 VERSION REVISED 5/30/79 -INCREASED MAX SYS PER BASE TO 400
6.  C        AND OTHER CORRECTIONS.
7.         CHARACTER*4 STYTL(8)
8.         COMMON /PRINT/IPRT(9),STYTL,CTIME,CDATE
9.         COMMON ISWTCH
10.        COMMON / BLK A /SIE, SBR, SDR,SDR2, SPSC, SPSO, SID, SIM,
11.       &                 SDM, SBMC, SDMC, SDC2, DF
12.        CHARACTER*8 CTIME,CDATE
13.        CALL ADATE(CTIME,CDATE)
14.        READ (  5,50) (IPRT(I),I=1,9),(STYTL(I),I=1,8)
15.     50 FORMAT (9I2,11X,8A4)
16.        CALL READA
17.        CALL READB
18.        CALL READC
19.        CALL READD
20.        CALL READE
21.        CALL LCCIN1
22.        IF(IPRT(1).NE.1)GO TO 100
23.        CALL WRTA
24.        CALL WRTB
25.        CALL WRTC
26.        CALL WRTD
27.        CALL WRTE
28.    100 CONTINUE
29.        CALL CCHECK
30.    200 CONTINUE
31.        CALL CCOMP
32.        CALL GRCOMP
33.        CALL VALID
34.        CALL SERC
35.        IF(IPRT(2).EQ.1.AND.ISWTCH.LE.0) CALL OUTOP2
36.        CALL SREQ
37.        IF(IPRT(4).EQ.1.AND.ISWTCH.LE.0) CALL OUTOP3
38.        CALL MPREQ
39.        IF(IPRT(5).EQ.1.AND.ISWTCH.LE.0) CALL PRNTMP
40.        IF(IPRT(5).EQ.1.AND.ISWTCH.LE.0) CALL REJECT
41.        CALL ACE
42.        CALL OMC
43.        CALL SUCM(0)
44.        CALL DCM
45.        CALL SUCM(1)
46.        CALL OUTOP4
47.        IF(ISWTCH.NE.0) CALL COMPOS
48.        ISWTCH=-ISWTCH
49.        IF(ISWTCH.EQ.-1) GO TO 200
50.        CALL LCCIN2
```

```
51.        GO TO 200
52.        END
53.        SUBROUTINE ACE
54.        COMMON / SYSBAS /NALCC(400),IALCC(400),NALCO(400),IALCO(400),
55.      &              NSC,NSO
56.        COMMON / SPRDAT /NRS(500),SRUS(500),LRUS(500),SRUMAX, LRUMAX,
57.      &              NRS2(500)
58.        INTEGER SRUS, SRUMAX
59.        COMMON / ACEDAT /AC(9,26), DAC(9,26)
60.        COMMON / ACTSCH /NAC(12,25), NCUM(12,25),    MACDEX
61.        COMMON / BLK A /SIE, SBR, SDR,SDR2, SPSC, SPSO, SID, SIM,
62.      &              SDM, SBMC, SDMC, SDC2, DF
63.        COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
64.      &              RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
65.      &              AO2, DSSF, NIS
66.        INTEGER WP
67.        COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
68.      &            MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
69.      &            RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
70.      &            LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
71.      &         USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
72.        REAL NRTS,NRTS2, MTBF
73.        CHARACTER*8 NAME(9)
74.        CHARACTER*4 ANAME,ANSE
75.        COMMON / BLK D /NSE, LSE(40), ANSE(40,5), CSE(40), COM(40)
76.        COMMON / BLK E /ACS, BTC, DTC, DCB, DCD, DCO, NPB, NPD, NPO,
77.      &              NI, CRSC, CRSO, CDMC, WPR
78.        COMMON / SUPDAT /IBREQ(40), IDREQ(40), IBR2(40), IDR2(40)
79.        COMMON /PRINT/IPRT(9),STYTL(8),CTIME,CDATE
80.        COMMON ISWTCH
81.        DIMENSION NOP(25), NCUMEQ(300),AC2(9,26)
82.        EQUIVALENCE (NCUMEQ,NCUM)
83.        DATA NAME /'INT TRIN','DATA AQ ','ITEM ENT','DATA MGT','PRIM HDR',
84.      &            'S.E.   ','INIT SP ','INST    ','WARRANTY'/
85.        KSTAR = ( MACDEX+11)/12
86.        DO 200 I=1,8
87.        DO 100 J=1,25
88.        AC(I,J)=0.0
89.   100 CONTINUE
90.   200 CONTINUE
91.        NTOT = NSC+NSO
92.        KSTAR1 = KSTAR-1
93.        DO 300 K = 1,KSTAR1
94.        NOP(K) = NCUM(12,K)
95.   300 CONTINUE
96.        NOP(KSTAR) = NCUMEQ( MACDEX)
97.        AC(1,1)=BTC
98.        AC(1,WP+1)=AC(1,WP+1)+DTC
99.        AC(2,1)=DCB+DCO
```

```
100.          AC(2,WP+1)=AC(2,WP+1)+DCD
101.          AC(3,WP+1)=FLOAT(NI)*SIE
102.          AC(4,1)=FLOAT((NPB+NPO)*(2*(NBC+NBO)+NTOT+5))*SID
103.          AC(4,WP+1)=AC(4,WP+1)+FLOAT(NPD*(2*(NBC+NBO)+NTOT+5))*SID
104.          AC(5,1)=FLOAT(NOP(1))*ACS
105.          IF(KSTAR.EQ.1)GO TO 700
106.          DO 600 K=2,KSTAR
107.          AC(5,K) = FLOAT(NOP(K)-NOP(K-1))*ACS
108.     600 CONTINUE
109.     700 CONTINUE
110.          TERM1=0.0
111.          TERM=0.0
112.          DO 800 J=1,NSE
113.          TERM=TERM+ FLOAT(IBREQ(J)-IBR2(J))*CSE(J)
114.          TERM1=TERM1+FLOAT(IDREQ(J)-IDR2(J))*CSE(J)
115.     800 CONTINUE
116.          IF(WP.EQ.0)TERM=TERM+TERM1
117.          AC(6,1)= FLOAT(NOP(1))*TERM/FLOAT(NTOT)
118.          IF(KSTAR .EQ. 1) GO TO 1000
119.          DO 900 K=2,KSTAR
120.          AC(6,K)= FLOAT(NOP(K)-NOP(K-1))*TERM/FLOAT(NTOT)
121.     900 CONTINUE
122.    1000 CONTINUE
123.          IF(WP.NE.0)AC(6,WP+1)=AC(6,WP+1)+TERM1
124.          IF(ISWTCH.NE.-1) GO TO 1005
125.          TERM2=0.0
126.          DO 1003 J=1,NSE
127.          TERM2=TERM2+FLOAT(IBR2(J)+IDR2(J))*CSE(J)
128.    1003 CONTINUE
129.          AC(6,ISP+1)=AC(6,ISP+1)+TERM2
130.    1005 CONTINUE
131.          TERM=0.0
132.          TERM1=0.0
133.          DO 1010 I=2,NRU
134.          IF(LREM(I).NE.2)TERM=TERM+FLOAT(NRS(I)-NRS2(I))*CRU(I)
135.          IF(LREM(I).EQ.2)TERM1=TERM1+FLOAT(NRS(I)-NRS2(I))*CRU(I)
136.    1010 CONTINUE
137.          IF(WP.EQ.0)TERM=TERM+TERM1
138.          AC(7,1)=FLOAT(NOP(1))*TERM/FLOAT(NTOT)
139.          IF(KSTAR.EQ.1)GO TO 1030
140.          DO 1020 K=2,KSTAR
141.          AC(7,K)=FLOAT(NOP(K)-NOP(K-1))*TERM/FLOAT(NTOT)
142.    1020 CONTINUE
143.    1030 CONTINUE
144.          IF(WP.NE.0)AC(7,WP+1)=AC(7,WP+1)+TERM1
145.          IF(ISWTCH.NE.-1) GO TO 1035
146.          TERM2=0.0
147.          DO 1032 I=2,NRU
148.          TERM2=TERM2+FLOAT(NRS2(I))*CRU(I)
149.    1032 CONTINUE
```

```
150.        AC(7,ISP+1)=AC(7,ISP+1)+TERM2
151.  1035 CONTINUE
152.        AC(8,1)=FLOAT(NOP(1))*SIN
153.        IF(KSTAR.EQ.1)GO TO 1050
154.        DO 1040 K=2,KSTAR
155.        AC(8,K)=FLOAT(NOP(K)-NOP(K-1))*SIN
156.  1040 CONTINUE
157.  1050 CONTINUE
158.        IF(WP.EQ.0) GO TO 1070
159.        AC(9,1)=FLOAT(NOP(1))*WPR/FLOAT(NTOT)
160.        IF(KSTAR.EQ.1)GO TO 1070
161.        DO 1060 K=2,KSTAR
162.        AC(9,K)=FLOAT(NOP(K)-NOP(K-1))*WPR/FLOAT(NTOT)
163.  1060 CONTINUE
164.  1070 CONTINUE
165.  9997 FORMAT(//15X,'ACQUISITION COST BREAKDOWN BY CATEGORY AND BY YEAR',
166.       &          /15X,50(1H-))
167.  9998 FORMAT(//' CATEGORY',30X,'YEAR'/' ',8(1H-),30X,'----'/8X,7I10)
168.        IF(ISWTCH) 1150,1170,1130
169.  1130 DO 1140 J=1,ISP
170.        DO 1135 I=1,9
171.        AC2(I,J)=AC(I,J)
172.  1135 CONTINUE
173.  1140 CONTINUE
174.        RETURN
175.  1150 DO 1160 J=1,ISP
176.        DO 1155 I=1,9
177.        IF(I.EQ.6.OR.I.EQ.7) GO TO 1155
178.        AC(I,J)=AC2(I,J)
179.  1155 CONTINUE
180.  1160 CONTINUE
181.  1170  IF(IPRT(7).NE.1) RETURN
182.        WRITE(6,9997)
183.        NY1=1
184.  1200 NY2=NY1+6
185.        IF(NY2.GT.NY) NY2=NY
186.        WRITE( 6,9998) (I,I=NY1,NY2)
187.        IF(NY2.EQ.NY) GO TO 9990
188.        WRITE( 6,9993)(NAME(N),(AC(N,IY),IY=NY1,NY2),N=1,9)
189.        NY1=NY1+7
190.        GO TO 1200
191.  9990  DO 9992 N=1,9
192.        WRITE( 6,9993)NAME(N),(AC(N,IY),IY=NY1,NY2)
193.  9992 CONTINUE
194.  9993 FORMAT(9(' ',A8,2X,7F10.0/))
195.  9995 RETURN
196.        END
197.        SUBROUTINE BSPARE(NSYS,ICONUS)
198.        COMMON / SPRDAT /NRS(500),SRUS(500),LRUS(500),SRUMAX, LRUMAX,
199.       &                 NRS2(500)
```

```
200.        INTEGER SRUS, SRUMAX
201.        COMMON / RELIAB   /G(26), GR(12,25), GM,ENR(500,25), EPM(25)
202.        COMMON / BLK E /ACS, BTC, DTC, DCB, DCD, DCO, NPB, NPD, NPO,
203.     &              NI, CRSC, CRSO, CDMC, WPR
204.        COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
205.     &              RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
206.     &              AO2, DSSF, NIS
207.        INTEGER WP
208.        COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
209.     &          MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
210.     &          RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
211.     &          LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
212.     &          USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
213.        REAL NRTS,NRTS2, MTBF
214.        CHARACTER*4 ANAME
215.        COMMON / BSPR /BLAMDA(500), BT(500),NSB(500)
216.        INTEGER SRUDEX
217.        DO 10 I = 1,500
218.        NSB(I) = 0
219.     10 CONTINUE
220.        IF ( ICONUS .EQ. MCONUS ) GO TO 20
221.        IF ( ICONUS .EQ. 1 .AND. WP .EQ. 0 ) RSTM = RSTC
222.        IF ( ICONUS .EQ. 3 .AND. WP .EQ. 0 ) RSTM = RSTO
223.        IF ( ICONUS .EQ. 1 .AND. WP .NE. 0 ) RSTM = CRSC
224.        IF ( ICONUS .EQ. 3 .AND. WP .NE. 0 ) RSTM = CRSO
225.     20 MCONUS = ICONUS
226.        IF ( SRUMAX .LT. 1 ) GO TO 150
227.        IF(ICONUS.EQ.1.OR.ICONUS.EQ.3) GO TO 150
228.        DO 100 SRUDEX = 1,SRUMAX
229.        IDEX = SRUS(SRUDEX)
230.        BT(IDEX) = BTCOMP(IDEX,RSTM,NSYS)
231.    100 CONTINUE
232.        CALL MARGNL(NSYS,SRUS,SRUMAX,AO2)
233.        RETURN
234.    150 DO 200 LRUDEX = 1,LRUMAX
235.        IDEX = LRUS(LRUDEX)
236.        BT(IDEX) = BTCOMP(IDEX,RSTM,NSYS)
237.    200 CONTINUE
238.        CALL MARGNL(NSYS,LRUS,LRUMAX,AO1)
239.        RETURN
240.        ENTRY BSINIT
241.        MCONUS = 999
242.        DUM = ESDINT(DUM)
243.        LRUDEX = 0
244.        SRUDEX = 0
245.        DO 400 I = 2,NRU
246.        IF ( LREM(I) .EQ. 0 ) GO TO 300
247.        IF ( LREM(I) .NE. 1 ) GO TO 400
248.        SRUDEX = SRUDEX + 1
249.        SRUS(SRUDEX) = I
```

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250.          GO TO 400
251.      300 CONTINUE
252.          LRUDEX = LRUDEX + 1
253.          LRUS(LRUDEX) = I
254.      400 CONTINUE
255.          LRUMAX = LRUDEX
256.          SRUMAX = SRUDEX
257.          DO 500 I = 2,NRU
258.          BLAMDA (I) = FLOAT(NQ(I))*(OH/730.)/((1.-UFP(I))*GM*MTBF(I))
259.      500 CONTINUE
260.          RETURN
261.          END
262.          FUNCTION BTCOMP(IDEX,RSTM,NSYS)
263.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
264.        &          MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
265.        &            RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
266.        &            LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
267.        &          USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
268.          REAL NRTS,NRTS2, MTBF
269.          CHARACTER*4 ANAME
270.          COMMON / XVALS /XNRTS(500),XRTS(500),XCOND(500)
271.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
272.        &            RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
273.        &            AO2, DSSF, NIS
274.          INTEGER WP
275.          IF ( LV(IDEX) .EQ. 1 .AND. LR(IDEX) .EQ. 1 )
276.        & BTCOMP = (XNRTS(IDEX)+XCOND(IDEX))*RSTM + XNRTS(IDEX)*ESD(IDEX) +
277.        &          (XRTS(IDEX)+UFP(IDEX))*TAT + XRTS(IDEX)*EBD(IDEX,NSYS)
278.          IF ( LV(IDEX) .EQ. 1 .AND. LR(IDEX) .EQ. 2 )
279.        & BTCOMP = (XNRTS(IDEX)+XRTS(IDEX))*(RSTM+ESD(IDEX)) +
280.        &            XCOND(IDEX)*RSTM + UFP(IDEX)*TAT
281.          IF ( LV(IDEX) .EQ. 2 .AND. LR(IDEX) .EQ. 2 )
282.        & BTCOMP = RSTM + (XNRTS(IDEX)+XRTS(IDEX)+UFP(IDEX))*ESD(IDEX)
283.          RETURN
284.          END
285.          SUBROUTINE CCOMP
286.          COMMON/PRINT/IPRT(9),STYTL,CTIME,CDATE
287.          CHARACTER*8 CTIME,CDATE
288.          CHARACTER*4 STYTL(8)
289.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
290.        &          MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
291.        &            RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
292.        &            LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
293.        &          USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
294.          REAL NRTS,NRTS2, MTBF
295.          COMMON / XVALS /XNRTS(500),XRTS(500),XCOND(500)
296.          IF(IPRT(9).GT.0) THEN
297.          WRITE (6,49)
298.          ENDIF
299.       49 FORMAT('1CCOMP   I',5X,'RTS',9X,'XNRTS',9X,'XRTS',8X,'XCOND',9X,
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300.         1'COND',9X,'NRTS',9X,'UFP',/)
301.          DO 100 I = 1,NRU
302.          RTS(I) = 1. - COND(I) - NRTS(I)
303.          XNRTS(I) = NRTS(I)*(1.-UFP(I))
304.          XRTS(I) = RTS(I)*(1.-UFP(I))
305.          XCOND(I) = COND(I)*(1.-UFP(I))
306.          IF(IPRT(9).GT.0) THEN
307.          WRITE (6,50) I,RTS(I),XNRTS(I),XRTS(I),XCOND(I),COND(I),NRTS(I),
308.         1UFP(I)
309.          ENDIF
310.       50 FORMAT('        ',I3,7E13.5)
311.      100 CONTINUE
312.          DO 300 I = 1,NRU
313.          LREM(I) =0
314.          IND = IN(I) - 1
315.          IF ( IND .EQ. 0 ) GO TO 300
316.          DO 200 J = 2,I
317.          INDEX = I-J+1
318.          IF ( IN(INDEX) .NE. IND ) GO TO 200
319.          LREM(I) = LR(INDEX)
320.          GO TO 300
321.      200 CONTINUE
322.      300 CONTINUE          .
323.          IF(NRU.GT.20) RETURN
324.          IF(IPRT(9).GT.0) THEN
325.          WRITE (6,500)  (LREM(I),I=1,NRU)
326.          ENDIF
327.      500 FORMAT (' *',20I3)
328.          RETURN
329.          END
330.          SUBROUTINE CSPARE
331.          COMMON/PRINT/IPRT(9),STYTL,CTIME,CDATE
332.          CHARACTER*8 CTIME,CDATE
333.          CHARACTER*4 STYTL(8)
334.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
335.         &          MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
336.         &          RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
337.         &          LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
338.         &          USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
339.          REAL NRTS,NRTS2, MTBF
340.          CHARACTER*4 ANAME
341.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
342.         &                RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
343.         &                AO2, DSSF, NIS
344.          INTEGER WP
345.          COMMON / CSPR / NCS(500)
346.          COMMON / RELIAB   /G(26), GR(12,25), GM,ENR(500,25), EPM(25)
347.          COMMON / XVALS /XNRTS(500),XRTS(500),XCOND(500)
348.          LL=1
349.          IF(WP.GT.0)LL=WP+1
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350.          DO 200 I = 2,NRU
351.          FNCS = 0.
352.          IF(IPRT(9).GT.0) THEN
353.          WRITE (6,500) I,LL,WP,XCOND(I)
354.          ENDIF
355.      500 FORMAT (' CSPARE 1',3I10,E12.4)
356.          DO 100 K = LL,NY
357.          FNCS = FNCS + ENR(I,K)*XCOND(I)
358.      100 CONTINUE
359.          NCS(I) = ICEIL(FNCS)
360.      200 CONTINUE
361.          RETURN
362.          END
363.          SUBROUTINE DCM
364.          COMMON / OMCDAT /OM(7,26), DOM(7,26)
365.          COMMON / ACEDAT /AC(9,26), DAC(9,26)
366.          COMMON / BLK A /SIE, SBR, SDR,SDR2, SPSC, SPSO, SID, SIM,
367.      &                   SDM, SBMC, SDMC, SDC2, DF
368.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
369.      &                   RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
370.      &                   AO2, DSSF, NIS
371.          INTEGER WP
372.          TERM1 = 1.0
373.          TERM = 1.0/(1.0 + DF)
374.          DO 300 K = 1 , NY
375.          DO 100 I = 1 , 8
376.          DAC(I,K)=AC(I,K) * TERM1
377.      100 CONTINUE
378.          IF(WP.NE.0)DAC(9,K)=AC(9,K) * TERM1
379.          DO 200 I = 1 , 7
380.          DOM(I,K)=OM(I,K) * TERM1
381.      200 CONTINUE
382.          TERM1=TERM1*TERM
383.      300 CONTINUE
384.          RETURN
385.          END
386.          SUBROUTINE DECODE(NAME,IDIM,ICOMN,ICOMDX,ITYPE,IERR)
387.          COMMON / BLK D /NSE, LSE(40), ANSE(40,5), CSE(40), COM(40)
388.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
389.      &            MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
390.      &              RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
391.      &              LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
392.      &            USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
393.          REAL NRTS,NRTS2, MTBF
394.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
395.      &                   RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
396.      &                   AO2, DSSF, NIS
397.          INTEGER WP
398.          CHARACTER*4 ANAME,NAME,ANSE,NAMES(66)
399.          DIMENSION IDIMA(3),INFO(66)
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400.          INTEGER TLIM
401.          DATA TLIM/63/
402.          DATA NAMES/
403.     &    'SIE',    'SBR',    'SDR',    'SDR2',   'SPSC',   'SPSO',
404.     &    'SID',    'SIM',    'SDM',    'SBMC',   'SDMC',   'SDC2',
405.     &    'DF',
406.     &    'SIN',    'OH',     'NDS',    'RSTC',   'RSTO',   'DMC',
407.     &    'DRC',    'BDSC',   'BDSO',   'TAT',    'WP',     'ISP',
408.     &    'AO1',    'AO2',    'DSSF',   'NIS',
409.     &    'NQ',     'CRU',    'MTBF',   'UFP',    'W',      'FVS',
410.     &    'RLS',    'RRS',    'RMS',    'NRTS',   'COND',   'LV',
411.     &    'LV2',    'LSEV',   'USEV',   'LR',     'LR2',
412.     &    'CSE',    'COM',
413.     &    'ACS',    'BTC',    'DTC',    'DCB',    'DCD',    'DCO',
414.     &    'NPB',    'NPD',    'NPO',    'NI',     'CRSC',   'CRSO',
415.     &    'CDMC',   'WPR',
416.     &    'G',
417.     &    3*' '/
418.          DATA INFO/
419.     &    0010001,  0010002,  0010003,  0010004,  0010005,  0010006,
420.     &    0010007,  0010008,  0010009,  0010010,  0010011,  0010012,
421.     &    0010013,
422.     &    0020006,  0020007,  0120008,  0020009,  0020010,  0020011,
423.     &    0020012,  0020013,  0020014,  0020015,  0120016,  0020017,
424.     &    0020018,  0020019,  0020020,  0020021,
425.     &    1130352,  1030402,  1030452,  1030502,  1030552,  1030602,
426.     &    1030652,  1030702,  1030752,  1030802,  1030852,  1130902,
427.     &    1130952,  1031002,  1131052,
428.     &    2040062,  2040072,
429.     &    0050001,  0050002,  0050003,  0050004,  0050005,  0050006,
430.     &    0150007,  0150008,  0150009,  0150010,  0050011,  0050012,
431.     &    0050013,  0050014,
432.     &    3060001,
433.     &    5*0/
434.       IDIMA(1) = NRU
435.       IDIMA(2) = NSE
436.       IDIMA(3)=NY+1
437.       DO 100 I = 1 , TLIM
438.       INDEX = I
439.       IF ( NAMES(I) .EQ. NAME ) GO TO 200
440.  100 CONTINUE
441.       IERR = 1
442.       RETURN
443.  200 CONTINUE
444.       ITEMP = INFO(INDEX)
445.       IDIMX = ITEMP/1000000
446.       ITEMP = ITEMP - IDIMX*1000000
447.       ITYPE = ITEMP/100000
448.       ITEMP = ITEMP - ITYPE*100000
449.       ICOMN = ITEMP/10000
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450.          ICOMDX = ITEMP - ICOMN*10000
451.          IDIM=0
452.          IF ( IDIMX .NE. 0 ) IDIM = IDIMA(IDIMX)
453.          IERR = 0
454.          RETURN
455.          END
456.          SUBROUTINE DSPARE
457.          COMMON/PRINT/IPRT(9),STYTL,CTIME,CDATE
458.          CHARACTER*8 CTIME,CDATE
459.          CHARACTER*4 STYTL(8)
460.          COMMON / BLK E /ACS, BTC, DTC, DCB, DCD, DCO, NPB, NPD, NPO,
461.         &                NI, CRSC, CRSO, CDMC, WPR
462.          COMMON / SYSBAS /NALCC(400),IALCC(400),NALCO(400),IALCO(400),
463.         &                NSC,NSO
464.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
465.         &                RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
466.         &                AO2, DSSF, NIS
467.          INTEGER WP
468.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
469.         &                MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
470.         &                RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
471.         &                LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
472.         &                USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
473.          REAL NRTS,NRTS2, MTBF
474.          CHARACTER*4 ANAME
475.          COMMON / RELIAB   /G(26), GR(12,25), GM,ENR(500,25), EPM(25)
476.          COMMON / DSPR /DLAMDA(500),DT(500),NSD(500)
477.          NTOT = NSC+NSO
478.          GX = GM
479.          IF ( WP .NE. 0 ) GX = G(WP+1)
480.          DO 300 IDEX = 1,NRU
481.          I = NRU-IDEX+1
482.          IF ( I .EQ. 1 ) GO TO 300
483.          DLAMDA(I) = FLOAT(NTOT*NQ(I))*(OH/730.)*X(I) /
484.         &                ((1.-UFP(I))*GX*MTBF(I))
485.          XYZ = X(I)
486.          IF(IPRT(9).GT.0) THEN
487.          WRITE (6,550) I,NTOT,NQ(I),UFP(I),GX,MTBF(I),XYZ
488.          ENDIF
489.    550 FORMAT (' DSPARE 1',3I5,4E12.3)
490.          IF ( LREM(I) .NE. 2 ) GO TO 100
491.          DT(I) = TD(I)
492.          GO TO 200
493.    100 CONTINUE
494.          DT(I) = BDSC*FLOAT(NSC)/FLOAT(NTOT) + BDSO*FLOAT(NSO)/FLOAT(NTOT)
495.          IF ( WP .EQ. 0 ) DT(I) = DT(I) + TD(I)
496.          IF ( WP .NE. 0 ) DT(I) = DT(I) + CDMC
497.    200 CONTINUE
498.          TEMP = DLAMDA(I)*DT(I)
499.          NSD(I) = ICEIL(TEMP+DSSF*SQRT(TEMP))
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500.          IF(IPRT(9).GT.0) THEN
501.          WRITE (6,500) I,TEMP,DLAMDA(I),DT(I),DSSF
502.          ENDIF
503.     500 FORMAT (' ** ',I3,4E12.3)
504.     300 CONTINUE
505.          RETURN
506.          END
507.          FUNCTION EBD(I,NSYS)
508.          COMMON / BSPR /BLAMDA(500), BT(500),NSB(500)
509.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
510.        &              MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
511.        &                RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
512.        &                LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
513.        &              USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
514.          REAL NRTS,NRTS2, MTBF
515.          CHARACTER*4 ANAME
516.          EBD = 0.
517.          I1 = I + 1
518.          IF ( I1 .GT. NRU ) RETURN
519.          XNUMER = 0.
520.          XDENOM = 0.
521.          DO 100 IDEX = I1,NRU
522.          INDEX = IDEX
523.          IF ( IN(IDEX) .NE. IN(I)+1 ) GO TO 200
524.          FNSLAM = FLOAT(NSYS) * BLAMDA (IDEX)
525.          XNUMER = XNUMER + FNSLAM
526.          XDENOM = XDENOM + FNSLAM*POISON (FNSLAM,BT(IDEX),NSB(IDEX))
527.     100 CONTINUE
528.          GO TO 300
529.     200 CONTINUE
530.          IF ( INDEX .EQ. I1 ) RETURN
531.     300 CONTINUE
532.          IF ( ABS(XDENOM) .GT. 1.E-9 ) EBD = XNUMER/XDENOM
533.          RETURN
534.          END
535.          FUNCTION EDD(I)
536.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
537.        &              MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
538.        &                RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
539.        &                LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
540.        &              USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
541.          REAL NRTS,NRTS2, MTBF
542.          CHARACTER*4 ANAME
543.          COMMON / DSPR /DLAMDA(500),DT(500),NSD(500)
544.          EDD = 0.
545.          I1 = I+1
546.          IF ( I1 .GT. NRU ) RETURN
547.          XNUMER = 0.
548.          XDENOM = 0.
549.          DO 100 IDEX = I1,NRU
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550.          INDEX = IDEX
551.          IF ( IN(IDEX) .NE. IN(I)+1 ) GO TO 200
552.          DL = DLAMDA(IDEX)
553.          XNUMER = XNUMER + DL*POISON (DL,DT(IDEX),NSD(IDEX))
554.          XDENOM = XDENOM + DL
555.    100 CONTINUE
556.          GO TO 300
557.    200 CONTINUE
558.          IF ( INDEX .EQ. I1 ) RETURN
559.    300 CONTINUE
560.          IF ( ABS(XDENOM) .GT. 1.E-9 ) EDD = XNUMER/XDENOM
561.          RETURN
562.          END
563.          SUBROUTINE EDNUM(LEN,IDECS,AMOUN,OUTPUT)
564.          CHARACTER*1 OUTPUT(20),OLL(4)
565.          CHARACTER*1 NUM(10),DECPT,COMMA,MINUS,BLANK,OUTSTR(20),IOLL
566.          EQUIVALENCE (OLL(1),IOLL)
567.          DATA NUM/'0','1','2','3','4','5','6','7','8','9'/
568.          DATA DECPT,COMMA,MINUS,BLANK/'.',',','-',' '/
569.          IF (AMOUN.GT.1E12) GO TO 600
570.          NEG = 0
571.          IF ( AMOUN .LT. 0. ) NEG = 1
572.          AMOUNT = ABS(AMOUN) + .5*(10.**(-IDECS))
573.           MOSTSG = 1
574.          IF ( AMOUNT .GE. 1. )  MOSTSG = ALOG10(AMOUNT) + 1
575.          NUMCOM = ( MOSTSG - 1)/3
576.          DO 10 I = 1,LEN
577.          OUTSTR(I) = BLANK
578.     10 CONTINUE
579.          IAMT = AMOUNT
580.          IF ( IDECS .EQ. 0 ) GO TO 200
581.          B = AMOUNT - IAMT
582.          IB = B * (10**IDECS) + .000001
583.          ISTRT = LEN-IDECS+1
584.          ID = 10**(IDECS-1)
585.          DO 100 I=ISTRT,LEN
586.          IB1 = IB/ID
587.          OUTSTR(I) = NUM(IB1 + 1)
588.          IB = IB - IB1*ID
589.          ID = ID/10
590.    100 CONTINUE
591.    200 OUTSTR(LEN-IDECS) = DECPT
592.          ISTOP = LEN - IDECS - 1
593.          ISTRT = ISTOP - ( MOSTSG+NUMCOM) + 1
594.          ID = 10**( MOSTSG-1)
595.          IF(ISTRT.LE.0.OR.ISTOP.LT.ISTRT) GO TO 700
596.          DO 400 I = ISTRT,ISTOP
597.          IF (MOD(ISTOP-I+1,4).EQ.0)GO TO 300
598.          IB1 = IAMT/ID
599.          OUTSTR(I) = NUM(IB1 + 1)
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600.          IAMT = IAMT - IB1*ID
601.          ID = ID/10
602.          GO TO 400
603.    300 OUTSTR(I) = COMMA
604.    400 CONTINUE
605.          IF ( NEG .EQ. 1 ) OUTSTR(ISTRT-1) = MINUS
606.          II=((LEN+3)/4)*4
607.    450 DO 500 I=1,II
608.          IOLL=OUTSTR(I)
609.    500 OUTPUT(I) = OLL(1)
610.          RETURN
611.    600 WRITE (6,650) AMOUN
612.    650 FORMAT('  VALUE INPUT TO EDNUM IS TOO LARGE',E12.3)
613.          RETURN
614.    700 DO 750 I=1,20
615.    750 OUTSTR(I)=MINUS
616.          GO TO 450
617.          END
618.          FUNCTION ESD(I)
619.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
620.        &          MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
621.        &            RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
622.        &            LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
623.        &          USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
624.          REAL NRTS,NRTS2, MTBF
625.          CHARACTER*4 ANAME
626.          COMMON / DSPR /DLAMDA(500),DT(500),NSD(500)
627.          DIMENSION XESD(500)
628.          IF ( XESD(I) .GT. 1.E30 ) XESD(I) = POISON (DLAMDA(I),DT(I),
629.        &                                        NSD(I))
630.          ESD = XESD(I)
631.          RETURN
632.          ENTRY  ESDINT(DUM)
633.          DO 200 I = 1,NRU
634.          XESD(I) = 1.E31
635.    200 CONTINUE
636.          ESDINT = DUM
637.          RETURN
638.          END
639.          SUBROUTINE GRCOMP
640.          COMMON /PRINT/IPRT(9),STYTL(8),CTIME,CDATE
641.          CHARACTER*8 CTIME,CDATE
642.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
643.        &          MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
644.        &            RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
645.        &            LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
646.        &          USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
647.          REAL NRTS,NRTS2, MTBF
648.          COMMON / ACTSCH /NAC(12,25), NCUM(12,25),    MACDEX
649.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
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650.          &                     RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
651.          &                     AO2, DSSF, NIS
652.          INTEGER WP
653.          COMMON / RELIAB    /G(26), GR(12,25), GM,ENR(500,25), EPM(25)
654.          DIMENSION GREQ(300)
655.          EQUIVALENCE (GREQ,GR)
656.          DO 500 K = 1,NY
657.          GR(1,K) = G(K)
658.  ***** WRITE(6,2020) K,(NCUM(J,K),J=1,12)
659.   2020 FORMAT(2X,13I8)
660.          IDENOM = 0
661.          DO 200 J = 1,12
662.          IDENOM = IDENOM + NCUM(J,K)
663.    200 CONTINUE
664.          DO 400 M = 2,12
665.          NUMER = 0
666.          LIM = M-1
667.          DO 300 J = 1,LIM
668.          NUMER = NUMER + NCUM(J,K)
669.    300 CONTINUE
670.          GR(M,K) = ( G(K+1)-G(K) ) * FLOAT(NUMER) / FLOAT(IDENOM) + G(K)
671.    400 CONTINUE
672.  ***** WRITE (6,2010) K,(GR(M,K),M=1,12)
673.   2010 FORMAT (2X,I5,12F10.3)
674.    500 CONTINUE
675.          ICV=15
676.          IF(NY.LT.ICV) ICV=NY
677.          IF(IPRT(9).GT.0) THEN
678.          WRITE(   6,95000)(STYTL(I),I=1,8),CTIME,CDATE
679.  95000 FORMAT('1',3X,8A4,2(3X,A8))
680.          WRITE(   6,95001)
681.          ENDIF
682.  95001 FORMAT('0   I LREM(I) ENR(I,K) K=1,NY     (SUB GRCOMP)',/)
683.          DO 800 I = 1,NRU
684.          DO 700 K = 1,NY
685.          ENR(I,K) = 0.
686.          IF ( I .EQ. 1 ) GO TO 700
687.          DO 600 M = 1,12
688.          ENR(I,K) = ENR(I,K) + FLOAT(NCUM(M,K)*NQ(I))*OH/((1.-UFP(I))*
689.          &                     GR(M,K)*MTBF(I))
690.    600 CONTINUE
691.    700 CONTINUE
692.          IF(IPRT(9).GT.0) THEN
693.          WRITE (6,2030) I,LREM(I),(ENR(I,K),K=1,ICV)
694.          ENDIF
695.   2030 FORMAT (2I4,2X,15F7.1)
696.    800 CONTINUE
697.          GM = GREQ( MACDEX)
698.          IF(IPRT(9).GT.0) THEN
699.          WRITE (6,2050) RTS(1),MTBF(1)
```

```
700.          ENDIF
701.     2050 FORMAT (2X,2F12.3)
702.          DO 1000 K = 1,NY
703.          EPM(K) = 0.
704.          DO 900 M = 1,12
705.          EPM(K) = EPM(K) + FLOAT(NCUM(M,K)*NQ(1))*OH*RTS(1) /
706.        &                   (GR(M,K)*MTBF(1))
707.      900 CONTINUE
708.     1000 CONTINUE
709.          IF(IPRT(9).GT.0) THEN
710.          WRITE (6,2060) (EPM(K),I=1,NY)
711.          ENDIF
712.     2060 FORMAT ('0EPM(K),K=1,NY',/,2X,25F5.1)
713.          RETURN
714.          END
715.          FUNCTION ICEIL(X)
716.          ICEIL = IFIX(X)
717.          TEMP = FLOAT(IFIX(X))
718.          IF ( ABS(TEMP-X) .LT. 1.E-9 ) RETURN
719.          ICEIL = IFIX(X) + 1
720.          RETURN
721.          END
722.          SUBROUTINE LCCIN
723.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
724.        &                RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
725.        &                AO2, DSSF, NIS
726.          INTEGER WP
727.          COMMON / COSSUM /TOTACQ(26), TOTOM(26), TOTCOS(26),
728.        &                  DOTACQ(26), DOTOM(26), DOTCOS(26)
729.          COMMON /PRINT/IPRT(9),STYTL(8),CTIME,CDATE
730.          DIMENSION SUMHLD(500,3)
731.          CHARACTER*8 TIME,DATE,CONTRL ,FILE(5),FNAME
732.          CHARACTER*4 NEW,NO,OLD,YES,CFSTAT,END,INPUT
733.          CHARACTER*4 OPT(9,8),STRING
734.          DATA OLD /' OLD'/
735.          DATA NEW /' NEW'/
736.          DATA YES/' YES'/
737.          DATA NO/'  NO'/
738.          DATA CFSTAT/' OLD'/
739.          DATA END /'END '/
740.          DATA OPT
741.        & /'PARA','METE','R FI','LE P','RINT','OUT ',3*'    ',
742.        &  'SUPP','ORT ','EQUI','PMEN','T RE','QUIR','EMEN','TS ','    ',
743.        &  'SPAR','ES R','EQUI','REME','NTS ','(DET','AILE','D) ','    ',
744.        &  'SPAR','ES R','EQUI','REME','NTS ','(UNI','T TO','TALS',')   ',
745.        &  'MANP','OWER',' REQ','UIRE','MENT','S   ',3*'    ',
746.        &  'TOTA','L CO','ST S','UMMA','RY (','BY C','ATEG','ORY)','    ',
747.        &  'TOTA','L CO','ST S','UMMA','RY (','BY Y','EAR)','    ','    ',
748.        &  'SENS','ITIV','ITY ','ANAL','YSIS',4*'    '/
749.          CALL ADATE(TIME,DATE)
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750.          WRITE(  6,100)DATE
751.    100 FORMAT(20X,'LIFE CYCLE COST ANALYSIS PROGRAM'/
752.      &       20X,32(1H-)//32X,A8/32X,'--------')
753.          WRITE(  6,200)
754.    200 FORMAT(//' YOU WILL BE PROMPTED FOR THE NECESSARY CONTRL  INPUT'/,
755.      &' TO RUN LCC. ANSWER ALL QUESTIONS CAREFULLY')
756.    250 WRITE(  6,300)
757.    300 FORMAT(/' *****CONTRL  FILE STATUS*****'/6X,19(1H-))
758.          WRITE(  6,400)
759.    400 FORMAT(/1X,'YOU MAY USE AN OLD CONTRL  FILE OR CREATE A NEW ONE'//
760.      &,              ' (ENTER OLD OR NEW) ')
761.    500 READ(  5,  2)CFSTAT
762.          IF ( CFSTAT .EQ.  OLD  ) GO TO 600
763.          IF ( CFSTAT .EQ.  NEW  ) GO TO 800
764.          GO TO 500
765.    600 CONTINUE
766.          WRITE(  6,1200)
767.    700 WRITE(  6,1300)
768.          READ(  5,  1)CONTRL
769.          GO TO 1600
770.    760 WRITE(  6,1400)CONTRL
771.          GO TO 700
772.    800 CONTINUE
773.          WRITE(  6,1100)
774.    900 WRITE(  6,1300)
775.          READ(  5,  1)CONTRL
776.          FNAME = CONTRL
777.          GO TO 1600
778.    950 WRITE(  6,1550)CONTRL
779.          STOP
780.   1000 CONTINUE
781.          WRITE(  6,1500)CONTRL
782.          GO TO 900
783.   1100 FORMAT(' THIS RUN WILL CREATE A NEW CONTRL  FILE')
784.   1200 FORMAT(' THIS RUN WILL ACCESS AN EXISTING CONTRL  FILE')
785.   1300 FORMAT(/' ENTER CONTRL  FILE NAME')
786.   1400 FORMAT(/' CONTRL  FILE ',A8,' NOT FOUND IN CATALOG. TRY AGAIN,'
787.      &       /' OR HIT BREAK AND CHECK YOUR CATALOG BEFORE RERUNNING LCC')
788.   1500 FORMAT(/' A NEW CONTRL  FILE WAS REQUESTED, BUT ',A8,
789.      &       /' COULD NOT BE CREATED. TRY AGAIN')
790.   1550 FORMAT(/1X,A8,' WAS CREATED BUT COULD NOT BE ATTACHED. RERUN ',
791.      & /'LCC AFTER CHECKING YOUR AFT')
792.   1600 CONTINUE
793.          WRITE(  6,1700)CONTRL
794.   1700 FORMAT(' THE CONTRL  FILE FOR THIS RUN IS ',A8)
795.          IF( CFSTAT .EQ.  OLD  )GO TO 2400
796.          WRITE(  6,1800)
797.   1800 FORMAT(/,' *****PARAMETER FILE NAMES*****'/6X,20(1H-))
798.          READ(  5,  1)FILE
799.          DO 2200 I=1,5
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800.    2000 CONTINUE
801.         FNAME = FILE(I)
802.         LCODE = I+9
803.         GO TO 2200
804.    2050 CONTINUE
805.         GO TO 2000
806.    2200 CONTINUE
807.         DO 2300 I=1,5
808.         WRITE(      6,10000)FILE(I)
809.    2300 CONTINUE
810.         GO TO 2800
811.    2400 CONTINUE
812.         DO 2700 I=1,5
813.         READ(      5,10000)FILE(I)
814.    2500 CONTINUE
815.         FNAME = FILE(I)
816.         LCODE = I+9
817.         GO TO 2700
818.    2550 CONTINUE
819.         READ(  5,  1)FILE(I)
820.         GO TO 2500
821.    2700 CONTINUE
822.         READ(      5,10000)IPRT
823.         IF ( IPRT(1)+IPRT(2)+IPRT(3)+IPRT(4)+IPRT(5)+
824.       &    IPRT(6)+IPRT(7)+IPRT(8) .NE. 0 ) GO TO 3750
825.         WRITE(  6,2750)
826.         STOP
827.    2750 FORMAT(/' *****ERROR...NO OUTPUT REQUESTED, PROGRAM HALTED')
828.    2800 CONTINUE
829.    2900 WRITE(  6,3000)
830.    3000 FORMAT(///' *****PRINT CONTRL  OPTIONS*****'/6X,21(1H-)/
831.       &        /' DO YOU WANT OUTPUT OTHER THAN A TOTAL COST SUMMARY,'/
832.       &         ' BY CATEGORY AND BY YEAR'/
833.       &         ' (YES OR NO) ')
834.         READ(  5,  2)INPUT
835.         IF(INPUT.EQ. NO )GO TO 3700
836.         IF ( INPUT .NE.  YES  ) GO TO 2900
837.         WRITE(  6,3100)
838.    3100 FORMAT(' YOU WILL BE PROMPTED FOR PRINT CONTRL  INPUT'/
839.       &        ' IF YOU WANT A GIVEN REPORT ENTER (1) ELSE ENTER (0)')
840.         WRITE(  6,3200)
841.    3200 FORMAT(///)
842.    3250 DO 3500 J = 1,8
843.         WRITE(  6,3300)J,(OPT(I,J),I=1,9)
844.    3300 FORMAT(' OPTION ',I2,' ',9A4)
845.    3400 READ(  5,  3)IPRT(J)
846.         IF(IPRT(J).NE.1.AND.IPRT(J).NE.0)GO TO 3400
847.    3500 CONTINUE
848.         IF ( IPRT(1)+IPRT(2)+IPRT(3)+IPRT(4)+IPRT(5)+
849.       &    IPRT(6)+IPRT(7)+IPRT(8) .NE. 0 ) GO TO 3570
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850.         WRITE(  6,3550)
851.         GO TO 3250
852.   3550 FORMAT(/' NO OUTPUT REQUESTED, TRY AGAIN')
853.   3570 WRITE(      6,3600)IPRT
854.   3600 FORMAT(8(1X,I5))
855.         GO TO 3750
856.   3700 IPRT(1)=0
857.         IPRT(2)=0
858.         IPRT(3)=0
859.         IPRT(4)=0
860.         IPRT(5)=0
861.         IPRT(6)=1
862.         IPRT(7)=1
863.         IPRT(8)=1
864.         WRITE(      6,3600)IPRT
865.   3750 CONTINUE
866.         RETURN
867.      1 FORMAT (A8)
868.      2 FORMAT (A4)
869.      3 FORMAT (I4)
870.      4 FORMAT (F10.0)
871.      5 FORMAT (2F10.0,I5)
872.         ENTRY LCCIN1
873.         IF( CFSTAT .EQ.   OLD  )GO TO 5300
874.         WRITE(  6,3800)
875.   3800 FORMAT(/' *****PARAMETER CHANGES*****'/6X,17(1H-))
876.   3900 WRITE(  6,4000)
877.   4000 FORMAT(/' DO YOU WISH TO MAKE ANY PARAMETER CHANGES FOR THIS RUN',
878.        &      ' (YES OR NO) ')
879.         READ(  5,  2)INPUT
880.         IF(INPUT.EQ. NO )GO TO 5200
881.         IF ( INPUT .NE.  YES  ) GO TO 3900
882.         WRITE(  6,4100)
883.   4100 FORMAT(/
884.        & ' YOU WILL BE PROMPTED FOR CHANGES TO FILE PARAMETERS. IF YOU WIS
885.        &H'/
886.        & ' TO CHANGE ALL ELEMENTS OF AN ARRAY ENTER 0 WHEN PROMPTED FOR AR
887.        &RAY'/
888.        & ' ELEMENT. TO CHANGE ONE ELEMENT OF AN ARRAY ENTER AN ELEMENT NUM
889.        &BER'/
890.        & ' WHEN PROMPTED FOR ARRAY ELEMENT. WHEN NO FURTHER PARAMETER CHAN
891.        &GES'/
892.        & ' ARE TO BE MADE ENTER (END) FOR THE PARAMETER TO BE CHANGED')
893.   4200 WRITE(  6,4300)
894.   4300 FORMAT(//' ENTER PARAMETER TO BE CHANGED ')
895.         READ(  5,  2)STRING
896.         IF ( CFSTAT .EQ.   OLD  ) GO TO 5310
897.         IF(STRING.EQ. END  )GO TO 5200
898.         CALL DECODE(STRING,IDIM,ICOMN,ICOMDX,ITYPE,IERR)
899.         IF(IERR.EQ.0)GO TO 4500
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900.          WRITE(  6,4400)STRING
901.   4400 FORMAT(' ****ERROR..PARAMETER ',A4,' NOT FOUND, RETRY')
902.          GO TO 4200
903.   4500 IELMT=0
904.          IF(IDIM.EQ.0)GO TO 4900
905.   4600 WRITE(  6,4700)
906.   4700 FORMAT(' ENTER THE ARRAY ELEMENT TO BE CHANGED ')
907.          READ(  5,  3)IELMT
908.          IF ( CFSTAT .EQ.  OLD  ) GO TO 5400
909.          IF(IELMT.GE.0.AND.IELMT.LE.IDIM)GO TO 4900
910.          WRITE(  6,4800)IELMT,IDIM
911.   4800 FORMAT(' ****ERROR..ELEMENT SPECIFIED ',I3/
912.     &          ' OUT OF RANGE 0 TO ',I3)
913.          GO TO 4600
914.   4900 WRITE(  6,5000)
915.   5000 FORMAT(' ENTER NEW VALUE ')
916.          READ(  5,  4)VALNEW
917.          IF( CFSTAT .EQ.  OLD  )GO TO 5400
918.          WRITE(      6,10000)STRING,IELMT,VALNEW
919.          IF(IELMT.NE.0)IDIM=0
920.          IF(IELMT.EQ.0)IELMT=1
921.          IOFF=IELMT+ICOMDX-2
922.          DO 5100 I=1,IDIM
923.          IOFF=IOFF+1
924.          CALL SET(VALNEW,ICOMN,IOFF,ITYPE,1)
925.   5100 CONTINUE
926.          GO TO 4200
927.   5200 WRITE(      6,10000)
928.          GO TO 5800
929.   5300 CONTINUE
930.          READ(      5,10010)STRING,IELMT,VALNEW
931.   5310 IF(STRING.EQ. END )GO TO 5800
932.          CALL DECODE(STRING,IDIM,ICOMN,ICOMDX,ITYPE,IERR)
933.          IF(IERR.EQ.0)GO TO 5400
934.          WRITE(  6,4400)STRING
935.   5400 CONTINUE
936.          IF ( IDIM .EQ. 0 ) IELMT = 0
937.          IF(IELMT.GE.0.AND.IELMT.LE.IDIM)GO TO 5600
938.          WRITE(  6,5500)STRING,IELMT,IDIM
939.   5500 FORMAT(' ****ERROR..VARIABLE ',A4,' ELEMENT SPECIFIED ',I3/
940.     &          ' OUT OF RANGE 0 TO ',I3/' RETRY')
941.          GO TO 5300
942.   5600 CONTINUE
943.          IF(IELMT.NE.0)IDIM=0
944.          IF(IELMT.EQ.0)IELMT=1
945.          IOFF=IELMT+ICOMDX-2
946.          DO 5700 I=1,IDIM
947.          IOFF=IOFF+1
948.          CALL SET(VALNEW,ICOMN,IOFF,ITYPE,1)
949.   5700 CONTINUE
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950.          GO TO 5300
951.    5800 CONTINUE
952.          IF( CFSTAT .EQ.  OLD  )GO TO 7400
953.          WRITE(  6,5900)
954.    5900 FORMAT(///,' *****SENSITIVITY ANALYSIS*****'/6X,20(1H-)//)
955.    6000 WRITE(  6,6100)
956.    6100 FORMAT(' DO YOU WANT A SENSITIVITY ANALYSIS (YES OR NO) ')
957.          READ(  5,  2)INPUT
958.          IF(INPUT.EQ. NO )GO TO 7600
959.          IF ( INPUT .NE.  YES  ) GO TO 6000
960.    6200 WRITE(  6,6300)
961.    6300 FORMAT(' ENTER NAME OF SENSITIVITY PARAMETER ')
962.          READ(  5,  2)STRING
963.          CALL DECODE(STRING,IDIM,ICOMN,ICOMDX,ITYPE,IERR)
964.          IF(IERR.EQ.0)GO TO 6400
965.          WRITE(  6,4400)STRING
966.          GO TO 6200
967.    6400 CONTINUE
968.          IELMT=0
969.          IF(IDIM.EQ.0)GO TO 6600
970.          WRITE(  6,4700)
971.          READ(  5,  3)IELMT
972.          IF(IELMT.GT.0.AND.IELMT.LE.IDIM)GO TO 6500
973.          WRITE(  6,5500)STRING,IELMT,IDIM
974.          GO TO 6400
975.    6500 CONTINUE
976.    6600 WRITE(  6,6700)
977.          IELHLD = IELMT
978.    6700 FORMAT(/' ENTER THE INITIAL VALUE, FINAL VALUE, AND NUMBER OF'/
979.         & ' STEPS FOR WHICH RUNS ARE TO BE MADE. SEPARATE ENTRIES BY COMMAS
980.         &.'/
981.         & ' (INITIAL,FINAL,STEPS)? ')
982.          READ(  5,  5)STRT,STP,NINC
983.          IF(NINC.GT.1.AND.NINC.LE.50)GO TO 6900
984.          WRITE(  6,6800)
985.    6800 FORMAT(' ****ERROR..MINIMUM OF 2  MAXIMUM OF 50 STEPS')
986.          GO TO 6600
987.    6900 IF ( CFSTAT .EQ.  NEW  )
988.         & WRITE(     6,10000)STRING,IELMT,STRT,STP,NINC
989.    7000 CONTINUE
990.          VINC=(STP-STRT)/(NINC-1)
991.          INCCTR=0
992.          VAL=STRT-VINC
993.          ENTRY LCCIN2
994.          IF(NINC.EQ.0)STOP
995.          IF(INCCTR.LT.1)GO TO 7100
996.          SUMHLD(INCCTR,2)=TOTCOS(NY+1)
997.          SUMHLD(INCCTR,3)=DOTCOS(NY+1)
998.    7100 INCCTR=INCCTR+1
999.          VAL=VAL+VINC
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1000.          IF(INCCTR.GT.NINC)GO TO 7300
1001.          IF(IELMT.EQ.0)IELMT=1
1002.          IOFF = IELMT+ICOMDX-1
1003.          IF((IPRT(2)+IPRT(3)+IPRT(4)+IPRT(5)+IPRT(6)+IPRT(7)).NE.0)
1004.     &    WRITE(   6,7200)INCCTR,STRING,VAL
1005.    7200  FORMAT(  '1  CYCLE ',I2,' VARIABLE - ',A4,' SET TO ',F14.4)
1006.          CALL SET(VAL,ICOMN,IOFF,ITYPE,1)
1007.          SUMHLD(INCCTR,1)=VAL
1008.          RETURN
1009.    7300  IF(IPRT(9).EQ.1)CALL OUTOP6(STRING,NINC,SUMHLD,IELHLD)
1010.          STOP
1011.    7400  CONTINUE
1012.          READ(      5,10020)STRING,IELMT,STRT,STP,NINC
1013.          IELHLD = IELMT
1014.          IF ( STRING .EQ.  END  ) GO TO 7700
1015.          CALL DECODE(STRING,IDIM,ICOMN,ICOMDX,ITYPE,IERR)
1016.          IF(IERR.EQ.0)GO TO 7500
1017.          WRITE(   6,4400)STRING
1018.    7500  CONTINUE
1019.          IF ( IDIM .EQ. 0 .AND. IELMT .EQ. 0 ) GO TO 7000
1020.          IF ( IDIM .GE. IELMT .AND. IELMT .GT. 0 ) GO TO 7000
1021.          WRITE(   6,5500)STRING,IELMT,IDIM
1022.    7600  CONTINUE
1023.          WRITE(       6,10000)
1024.    7700  CONTINUE
1025.          NINC=0
1(            RETURN
102.    10000  FORMAT('   END,0,0,0,0')
1028.    10010  FORMAT(A4,I5,F10.0)
1029.    10020  FORMAT (A4,I6,2F10.0,I4)
1030.          END
1031.          SUBROUTINE MARGNL(NSYS,NRUS,NRUMAX,AO)
1032.          COMMON / BSPR /BLAMDA(500), BT(500),NSB(500)
1033.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
1034.     &              MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
1035.     &                 RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
1036.     &                 LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
1037.     &               USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
1038.          REAL NRTS,NRTS2, MTBF
1039.          DIMENSION NRUS(NRUMAX), D(500),NSPR(500),DELT(500),T(500)
1040.          CHARACTER*4 ANAME
1041.          DIMENSION DOL(500)
1042.          B = 0.
1043.          DO 100 I = 1,NRU
1044.          NSPR(I) = 0
1045.     100  CONTINUE
1046.          DO 200 IDEX = 1 , NRUMAX
1047.          I = NRUS(IDEX)
1048.          D(I) = FLOAT(NSYS)*BLAMDA (I)*BT(I)
1049.          B = B + D(I)
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VOLUME II OF II

RELIABILITY, MAINTAINABILITY AND

LIFE CYCLE COST EFFECTS OF USING

COMMERCIAL OFF-THE-SHELF EQUIPMENT

TECHNICAL REPORT

APPENDICES

PREPARED FOR
UNITED STATES AIR FORCE
AIR FORCE SYSTEMS COMMAND
ROME AIR DEVELOPMENT CENTER
GRIFFISS AIR FORCE BASE, NEW YORK
UNDER CONTRACT
F30602-80-C-0306
STATEMENT OF WORK
PR NO. N-0-5227
CLIN A003

NOVEMBER 9, 1982

APPROVED BY: _A.J. HAUTER_   PREPARED BY: _N.E. SCHMIDT_

COLLINS GOVERNMENT AVIONICS DIVISION

ROCKWELL INTERNATIONAL CORPORATION

CEDAR RAPIDS, IOWA

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1050.         T(I) = EXP(-D(I))
1051.         DELT(I) = 1. - T(I)
1052.         DOL(I)=DELT(I)/CRU(I)
1053.     200 CONTINUE
1054.         LOPCNT = 0
1055.     300 BOBJ = B / FLOAT(NSYS)
1056.         IF( BOBJ .LE. (1. - AO) )GO TO 600
1057.         I = NRUS(1)
1058.         DLMAX = DOL(I)
1059.         MINDEX = I
1060.         IF ( NRUMAX .EQ. 1 ) GO TO 500
1061.         DO 400 IDEX = 2 , NRUMAX
1062.         I = NRUS(IDEX)
1063.         TEMP = DOL(I)
1064.         IF( TEMP .LE. DLMAX ) GO TO 400
1065.         MINDEX = I
1066.         DLMAX = TEMP
1067.     400 CONTINUE
1068.     500 NSPR(MINDEX) = NSPR(MINDEX) + 1
1069.         B = B - DELT(MINDEX)
1070.         T(MINDEX) = T(MINDEX)*D(MINDEX)/FLOAT(NSPR(MINDEX))
1071.         DELT(MINDEX) = DELT(MINDEX) - T(MINDEX)
1072.         DOL(MINDEX)=DELT(MINDEX)/CRU(MINDEX)
1073.         LOPCNT = LOPCNT + 1
1074.         IF ( LOPCNT .GT. 150 ) GO TO 800
1075.         GO TO 300
1076.     800 WRITE(  6,900) BOBJ,AO
1077.     600 DO 700 I = 1,NRU
1078.         NSB(I) = NSB(I) + NSPR(I)
1079.     700 CONTINUE
1080.         RETURN
1081.     900 FORMAT('****ERROR...MARGINAL ANALYSIS DID NOT CONVERGE',2F10.3)
1082.         END
```

```
1.  C SECOND PORTION OF TASC LCC MODEL REVISED 1/25/80
2.  C 7/25/79 VERSION REVISED 1/25/80 - INCREASED MAX NRU 50 TO 500
3.  C 6/04/79 VERSION REVISED 7/25/79 - LCC-2A VERSION FROM DRC
4.  C 5/30/79 VERSION REVISED 6/4/79 - INCREASED MAX SE FROM 10 TO   40
5.  C 12/7/78 VERSION REVISED 5/30/79 - INCREASED MAX SYS PER BASE TO
6.  C        400 SYSTEMS PLUS OTHER MINOR CHANGES
7.        SUBROUTINE MPREQ
8.        COMMON / XVALS /XNRTS(500),XRTS(500),XCOND(500)
9.        COMMON / MANPWR   /FLMH(25), BLMH(25), DLMH(25)
10.       COMMON / RELIAB   /G(26), GR(12,25), GM,ENR(500,25), EPM(25)
11.       COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
12.      &          MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
13.      &          RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
14.      &          LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
15.      &          USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
16.       REAL NRTS,NRTS2,MTBF
17.       COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
18.      &              RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
19.      &              AO2, DSSF, NIS
20.       INTEGER WP
21.       COMMON ISWTCH
22.          CHARACTER*4 ANAME
23.       DIMENSION FLMH2(25),BLMH2(25),DLMH2(25)
24.       DO 40 K = 1,NY
25.       FLMH(K) = EPM(K)*RLS(1)
26.       DO 10 I = 2,NRU
27.       IF ( LREM(I) .EQ. 0 ) FLMH(K) = FLMH(K) + ENR(I,K)*RRS(I)
28.    10 CONTINUE
29.       BLMH(K) = 0.
30.       DO 20 I = 2,NRU
31.       IF ( LV(I) .EQ. 1 ) BLMH(K) = BLMH(K) + ENR(I,K)*FVS(I)
32.       IF ( LREM(I) .EQ. 1 ) BLMH(K) = BLMH(K) + ENR(I,K)*RRS(I)
33.    20 CONTINUE
34.       DLMH(K) = 0.
35.       IF ( K .LE. WP ) GO TO 40
36.       DO 30 I = 2,NRU
37.       IF ( LV(I) .GE. 2 ) DLMH(K) = DLMH(K) + ENR(I,K)*FVS(I)
38.       IF ( LR(I) .GE. 1 ) DLMH(K) = DLMH(K) + ENR(I,K)*
39.      &                      XNRTS(I)*RLS(I)
40.       IF ( LREM(I) .GE. 2 ) DLMH(K) = DLMH(K) + ENR(I,K)*RRS(I)
41.    30 CONTINUE
42.    40 CONTINUE
43.       IF(ISWTCH) 60,70,50
44.    50 DO 55 K=1,ISP
45.       FLMH2(K)=FLMH(K)
46.       BLMH2(K)=BLMH(K)
47.       DLMH2(K)=DLMH(K)
48.    55 CONTINUE
49.       RETURN
```

```
50.      60 DO 65 K=1,ISP
51.         FLMH(K)=FLMH2(K)
52.         BLMH(K)=BLMH2(K)
53.         DLMH(K)=DLMH2(K)
54.      65 CONTINUE
55.      70 RETURN
56.         END
57.         SUBROUTINE OMC
58.         COMMON / XVALS /XNRTS(500),XRTS(500),XCOND(500)
59.         COMMON / SUPDAT /IBREQ(40), IDREQ(40), IBR2(40), IDR2(40)
60.         COMMON / RELIAB  /G(26), GR(12,25), GM,ENR(500,25), EPM(25)
61.         COMMON / ACTSCH  /NAC(12,25), NCUM(12,25),  MACDEX
62.         COMMON / SYSBAS /NALCC(400), IALCC(400), NALCO(400),IALCO(400),
63.        &                 NSC, NSO
64.         COMMON / BLK A /SIE, SBR, SDR, SDR2, SPSC, SPSO, SID, SIM,
65.        &                 SDM, SBMC, SDMC, SDC2, DF
66.         COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
67.        &                 RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, A01,
68.        &                 A02, DSSF, NIS
69.         INTEGER WP
70.         COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
71.        &          MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
72.        &           RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
73.        &           LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
74.        &           USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
75.         REAL NRTS,NRTS2,MTBF
76.         COMMON / BLK D /NSE, LSE(40), ANSE      , CSE(40), COM(40)
77.         COMMON / BLK E /ACS, BTC, DTC, DCB, DCD, DCO, NPB, NPD, NPO,
78.        &                 NI, CRSC, CRSO, CDMC, WPR
79.         COMMON / OMCDAT /OM(7,26), DOM(7,26)
80.         COMMON ISWTCH
81.         COMMON / PRINT /IPRT(8),STYTL    ,CTIME,CDATE
82.         CHARACTER*8 NAME
83.            CHARACTER*4 STYTL(8),ANAME,ANSE(40,5)
84.         DIMENSION OM2(7,26),NAME(7)
85.         DATA NAME /'FLT L MT','BASE MT ','DEPOT MT','ITEM MGT',
86.        &           'DATA MGT','PK & SHP','S.E. MT.'/
87.         DO 200 K=1,25
88.         DO 100 J=1,7
89.         OM(J,K)=0.0
90.     100 CONTINUE
91.     200 CONTINUE
92.         DO 400 K = 1,NY
93.         DO 300 I = 2,NRU
94.         IF ( LV(I) .EQ. 1 ) OM(2,K) = OM(2,K) + ENR(I,K)*FVS(I)*SBR
95.         IF ( LREM(I) .EQ. 1 ) OM(2,K) = OM(2,K)+ENR(I,K)*RRS(I)*(SBR+SBMC)
96.     300 CONTINUE
97.     400 CONTINUE
98.         N = WP + 1
99.         DO 600 K=N,NY
```

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100.         DO 500 I=2,NRU
101.          IF ( LV(I) .GE. 2 ) OM(3,K) = OM(3,K) + ENR(I,K)*FVS(I)*SDR
102.          IF ( LR(I) .GE. 1 ) OM(3,K) = OM(3,K) + ENR(I,K)*XNRTS(I)*
103.      &                      (RLS(I)*(SDR+SDMC)+RMS(I))
104.          IF ( LREM(I) .GE. 2 ) OM(3,K) = OM(3,K) + ENR(I,K)*RRS(I)*
105.      &                      (SDR+SDMC)
106.     500 CONTINUE
107.     600 CONTINUE
108.         N = WP + 1
109.         TEMP=FLOAT(NI)*SIM
110.         DO 700 K=N,NY
111.         OM(4,K)=TEMP
112.     700 CONTINUE
113.         TEMP=FLOAT(NPB+NPO)*SDM
114.         TEMP1=FLOAT(NPD)*SDM
115.         DO 800 K=1,NY
116.         OM(5,K)=TEMP
117.         IF(K.GT.WP)OM(5,K)=OM(5,K)+TEMP1
118.     800 CONTINUE
119.         PSC = (FLOAT(NSC)*SPSC+FLOAT(NSO)*SPSO)/FLOAT(NSC+NSO)
120.         DO 1000 K=1,NY
121.         DO 900 I=2,NRU
122.         TERM = 2.*XNRTS(I) + XCOND(I)
123.         IF ( LR(I) .GE. 2 ) TERM = TERM + 2.*XRTS(I)
124.         IF ( LV(I) .GE. 2 ) TERM = TERM + 2.*UFP(I)+XCOND(I)
125.         IF ( LREM(I) .LE. 1 ) OM(6,K) = OM(6,K) + ENR(I,K)*TERM*W(I)*PSC
126.     900 CONTINUE
127.    1000 CONTINUE
128.         DO 1400 K = 1,NY
129.         DO 1100 J = 1,NSE
130.         OM(7,K) = OM(7,K) + FLOAT(IBREQ(J))*CSE(J)*COM(J)
131.    1100 CONTINUE
132.         IF ( K .LE. WP ) GO TO 1400
133.         ACTAVG = 0.
134.         DO 1200 M = 1,12
135.         ACTAVG = ACTAVG + FLOAT(NCUM(M,K))
136.    1200 CONTINUE
137.         ACTAVG = ACTAVG/12.
138.         DO 1300 J = 1,NSE
139.         OM(7,K) = OM(7,K) + FLOAT(IDREQ(J))*CSE(J)*COM(J)*ACTAVG/
140.      &                      FLOAT(NSC+NSO)
141.    1300 CONTINUE
142.    1400 CONTINUE
143.         DO 1600 K = 1,NY
144.         OM(1,K) = OM(1,K) + EPM(K)*(RLS(1)*SBR+RMS(1))
145.         DO 1500 I = 2,NRU
146.         IF ( LREM(I) .EQ. 0 ) OM(1,K) = OM(1,K) + ENR(I,K)*RRS(I)*SBR
147.    1500 CONTINUE
148.    1600 CONTINUE
149.    9997 FORMAT(//18X,'O & M COST BREAKDOWN BY CATEGORY AND BY YEAR'
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150.         &/18X,44(1H-))
151.   9998 FORMAT(//' CATEGORY',30X,'YEAR'/' ',8(1H-),30X,'----'/8X,7I10)
152.         IF(ISWTCH) 1750,1770,1730
153.   1730 DO 1745 K=1,ISP
154.         DO 1740 J=1,7
155.         OM2(J,K)=OM(J,K)
156.   1740 CONTINUE
157.   1745 CONTINUE
158.         RETURN
159.   1750 DO 1760 K=1,ISP
160.         DO 1755 J=1,7
161.         OM(J,K)= OM2(J,K)
162.   1755 CONTINUE
163.   1760 CONTINUE
164.   1770 IF(IPRT(7).NE.1) RETURN
165.         WRITE( 6,9997)
166.         NY1=1
167.   2000 NY2=NY1+6
168.         IF(NY2.GT.NY) NY2=NY
169.         WRITE ( 6,9998) (J,J=NY1,NY2)
170.         IF(NY2.EQ.NY) GO TO 2020
171.         WRITE(6,9999) (NAME(N),(OM(N,IY),IY=NY1,NY2),N=1,7)
172.         NY1=NY1+7
173.         GO TO 2000
174.   2020 DO 2022 N=1,7
175.         WRITE( 6,9999) NAME(N),(OM(N,IY),IY=NY1,NY2)
176.   2022 CONTINUE
177.   9995  RETURN
178.   9999 FORMAT(7(' ',A8,2X,7F10.0,/))
179.         END
180.         SUBROUTINE OUTOP2
181.         COMMON / BLK D /NSE, LSE(40), ANSE       , CSE(40), COM(40)
182.         COMMON / SUPDAT /IBREQ(40), IDREQ(40), IBR2(40), IDR2(40)
183.         COMMON / PRINT /IPRT(8),STYTL    ,CTIME,CDATE
184.         CHARACTER*8 CTIME,CDATE
185.            CHARACTER*4 STYTL(8),ANSE(40,5)
186.         CHARACTER*4 ACOST(4)
187.         WRITE(    6,95000)(STYTL(I),I=1,8),CTIME,CDATE
188.   95000 FORMAT('1',10X,8A4,2(3X,A8))
189.         WRITE( 6,90000)
190.         DO 100 J=1,NSE
191.         IF ( IBREQ(J) .EQ. 0 ) GO TO 100
192.         COST = FLOAT(IBREQ(J))*CSE(J)
193.         CALL EDNUM(16,0,COST,ACOST)
194.         WRITE( 6,90001)(ANSE(J,K),K=1,5),IBREQ(J),ACOST
195.    100 CONTINUE
196.         WRITE( 6,90010)
197.         DO 200 J=1,NSE
198.         IF ( IDREQ(J) .EQ. 0 ) GO TO 200
199.         COST = FLOAT(IDREQ(J))*CSE(J)
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200.          CALL EDNUM(16,0,COST,ACOST)
201.          WRITE(   6,90011)(ANSE(J,K),K=1,5),IDREQ(J),ACOST
202.     200 CONTINUE
203.          RETURN
204. 90000 FORMAT('0',20X,'SUPPORT EQUIPMENT REQUIREMENTS',/21X,30(1H-)//
205.      &10X,'LINE ITEMS OF SUPPORT EQUIPMENT REQUIRED AT BASE LEVEL'
206.      &    /10X,54(1H-)///8X,'EQUIPMENT',22X,'QUANTITY',11X,'COST'/
207.      &8X,9(1H-),22X,8(1H-),11X,4(1H-)//)
208. 90001 FORMAT(1X,5A4,19X,I3,5X,4A4)
209. 90010 FORMAT(//10X,'LINE ITEMS OF SUPPORT EQUIPMENT REQUIRED AT DEPOT',
210.      &' LEVEL'/10X,55(1H-)///8X,'EQUIPMENT',22X,'QUANTITY',11X,'COST'/
211.      &8X,9(1H-),22X,8(1H-),11X,4(1H-)//)
212. 90011 FORMAT(1X,5A4,19X,I3,5X,4A4)
213.          END
214.          SUBROUTINE OUTOP3
215.          COMMON / CSPR / NCS(500)
216.          COMMON / DSPR /DLAMDA(500),DT(500),NSD(500)
217.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
218.      &              MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
219.      &               RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
220.      &               LSEV(500),USEV(500),LR(500),IR2(500),LSER(500,4),
221.      &               USER(500,4),RTS(500),LREM(500),NR1S2(500),COND2(500)
222.          REAL NRTS,NRTS2,MTBF
223.          COMMON / SPRDAT /NRS(500),SRUS(500),LRUS(500),SRUMAX, LRUMAX,
224.      &                   NRS2(500)
225.          INTEGER SRUS, SRUMAX
226.          COMMON / PRINT /IPRT(8),STYTL     ,CTIME,CDATE
227.          CHARACTER*8 CTIME,CDATE
228.             CHARACTER*4 STYTL(8),ANAME
229.          CHARACTER*4 ACOST(4)
230.          WRITE(   6,95000)(STYTL(I),I=1,8),CTIME,CDATE
231. 95000 FORMAT('1',10X,8A4,2(3X,A8))
232.          WRITE(   6,90000)
233.          DO 100 I=1,NRU
234.          IF ( NRS(I) .EQ. 0 ) GO TO 100
235.          COST = FLOAT(NRS(I))*CRU(I)
236.          NSB = NRS(I) - NCS(I) - NSD(I)
237.          CALL EDNUM(16,0,COST,ACOST)
238.          WRITE(   6,90010)(ANAME(I,K),K=1,5),NSD(I),NSB,NCS(I),NRS(I),ACOST
239.     100 CONTINUE
240. 90000 FORMAT('0',20X,'SPARES REQUIREMENTS (UNIT TOTALS)',/21X,33(1H-)//
241.      & 35X,'SPARES'/22X,32(1H-),8X,'TOTAL'/
242.      & 2X,'REPLACEABLE UNIT   DEPOT   BASE   CONDEMNATION  TOTAL',
243.      & 8X,'COST'/
244.      & 2X,'----------------   -----  ----  ------------  -----',
245.      & 8X,'----')
246. 90010 FORMAT(1X,5A4,1X,I4,3X,I3,7X,I4,6X,I4,3X,4A4)
247.          RETURN
248.          END
249.          SUBROUTINE OUTOP4
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250.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
251.       &              RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
252.       &              AO2, DSSF, NIS
253.       INTEGER WP
254.       COMMON / OMCDAT /OM(7,26), DOM(7,26)
255.       COMMON / ACEDAT /AC(9,26), DAC(9,26)
256.       COMMON / COSSUM /TOTACQ(26), TOTOM(26), TOTCOS(26),
257.       &              DOTACQ(26), DOTOM(26), DOTCOS(26)
258.       COMMON / PRINT /IPRT(8),STYTL    ,CTIME,CDATE
259.       COMMON ISWTCH
260.          CHARACTER*4 STYTL(8)
261.       CHARACTER*8 CTIME,CDATE
262.       CHARACTER*4 ACH(6,9),ACTH(6),OMH(6,7),OMTH(6),TOTH(6)
263.       CHARACTER*4 COS1(4),COS2(4)
264.       DATA ACH/'    ','INIT','IAL ','TRAI','NING','    ',
265.       &         '    ','DATA',' ACQ','UISI','TION','    ',
266.       &         '    ','ITEM',' ENT','RY  ','    ','    ',
267.       &         '    ','DATA',' MAN','AGEM','ENT ','    ',
268.       &         '    ','PRIM','E HA','RDWA','RE  ','    ',
269.       &         '    ','SUPP','ORT ','EQUI','PMEN','T   ',
270.       &         '    ','INIT','IAL ','SPAR','ES  ','    ',
271.       &         '    ','INST','ALLA','TION','    ','    ',
272.       &         '    ','WARR','ANTY','    ','    ','    '/
273.       DATA OMH/'    ','FLIG','HT L','INE ','MAIN','T.  ',
274.       &         '    ','BASE',' LEV','EL M','AINT','.   ',
275.       &         '    ','DEPO','T LE','VEL ','MAIN','T.  ',
276.       &         '    ','ITEM',' MAN','AGEM','ENT ','    ',
277.       &         '    ','DATA',' MAN','AGEM','ENT ','    ',
278.       &         '    ','PACK','ING ','& SH','IPPI','NG  ',
279.       &         '    ','S.E.','MAIN','TENA','NCE ','    '/
280.       DATA ACTH/'  TO','TAL ','ACQU','ISIT','ION ','COST'/
281.       DATA OMTH/'  TO','TAL ','O&M ','COST','    ','    '/
282.       DATA TOTH/'TOTA','L LI','FE C','YCLE',' COS','T   '/
283.       IF(IPRT(6).EQ.0 .OR. ISWTCH .GT. 0) GO TO 100
284.       WRITE( 6,90021)
285.       WRITE( 6,95000)(STYTL(I),I=1,8),CTIME,CDATE
286. 95000 FORMAT('1',10X,8A4,2(3X,A8))
287.       WRITE( 6,90050)
288.       DO 60 M=1,8
289.       CALL EDNUM(16,0,AC(M,NY+1),COS1)
290.       CALL EDNUM(16,0,DAC(M,NY+1),COS2)
291.       WRITE( 6,90040)(ACH(MH,M),MH=1,6),COS1,COS2
292.  60 CONTINUE
293.       IF ( WP .EQ. 0 ) GO TO 65
294.       CALL EDNUM(16,0,AC(9,NY+1),COS1)
295.       CALL EDNUM(16,0,DAC(9,NY+1),COS2)
296.       WRITE( 6,90040)(ACH(MH,9),MH=1,6),COS1,COS2
297.  65 CONTINUE
298.       WRITE( 6,90222)
299.       CALL EDNUM(16,0,TOTACQ(NY+1),COS1)
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300.        CALL EDNUM(16,0,DOTACQ(NY+1),COS2)
301.        WRITE(  6,90040)(ACTH(MH),MH=1,6),COS1,COS2
302.        WRITE(  6,90021)
303.        DO 70 M=1,7
304.        CALL EDNUM(16,0,OM(M,NY+1),COS1)
305.        CALL EDNUM(16,0,DOM(M,NY+1),COS2)
306.        WRITE(  6,90040)(OMH(MH,M),MH=1,6),COS1,COS2
307.     70 CONTINUE
308.        WRITE(  6,90222)
309.        CALL EDNUM(16,0,TOTOM(NY+1),COS1)
310.        CALL EDNUM(16,0,DOTOM(NY+1),COS2)
311.        WRITE(  6,90040)(OMTH(MH),MH=1,6),COS1,COS2
312.        WRITE(  6,90021)
313.        WRITE(  6,90222)
314.        CALL EDNUM(16,0,TOTCOS(NY+1),COS1)
315.        CALL EDNUM(16,0,DOTCOS(NY+1),COS2)
316.        WRITE(  6,90040)(TOTH(MH),MH=1,6),COS1,COS2
317.    100 CONTINUE
318.        IF(IPRT(7).EQ.0.OR.ISWTCH.GT.0) RETURN
319.        WRITE(  6,95000)(STYTL(I),I=1,8),CTIME,CDATE
320.        ICV=NY+1
321.        I1=8
322.        IF(I1.GT.ICV)I1=ICV
323.        IF(ICV.GT.16) ICV=16
324.        I2=1
325.        WRITE(6,1)I2,I1
326.      1 FORMAT('0ACQUISITION COST PER YEAR, YEARS',I3,' THRU',I3,/)
327.        DO 5 I=1,9
328.      5 WRITE(6,7) I,(AC(I,K),K=1,I1)
329.      7 FORMAT(' ',I2,8F10.0)
330.        IF(ICV.LE.8) GO TO 15
331.        I2=9
332.        WRITE(6,1) I2,ICV
333.        DO 10 I=1,9
334.     10 WRITE(6,7) I,(AC(I,K),K=9,ICV)
335.     15 WRITE(  6,95000)(STYTL(I),I=1,8),CTIME,CDATE
336.        I2=1
337.     20 WRITE(6,21) I2,I1
338.     21 FORMAT('0O&M COST PER YEAR, YEARS',I3,' THRU',I3,/)
339.        DO 25 I=1,7
340.     25 WRITE(6,7) I, (OM(I,K),K=1,I1)
341.        IF(ICV.LE.8) GO TO 30
342.        I2=9
343.        WRITE(6,21) I2,ICV
344.        DO 28 I=1,7
345.     28 WRITE(6,7) I, (OM(I,K),K=9,ICV)
346.     30 CONTINUE
347.        WRITE(  6,95000)(STYTL(I),I=1,8),CTIME,CDATE
348.        WRITE(  6,91000)NY
349.  91000 FORMAT('0',20X,'TOTAL COST SUMMARY (BY YEAR)',/
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350.        &                  21X,28(1H-)//,
351.        &          1X,'SYSTEM OPERATIONAL LIFE = ',I2,' YEARS'//
352.        &              1X,'YEAR OF',10X,'UNDISCOUNTED',12X,'PRESENT VALUE',/
353.        &,         1X,'PROGRAM',10X,'   COST   ',12X,'    COST',/
354.        &          1X,'-------',10X,'   ----   ',12X,'    ----',/)
355.         DO 1111 I=1,NY
356.         CALL EDNUM(16,0,TOTCOS(I),COS1)
357.         CALL EDNUM(16,0,DOTCOS(I),COS2)
358.         WRITE(  6,91010)I,COS1,COS2
359. 91010 FORMAT(4X,I2,10X,4A4,8X,4A4)
360.  1111 CONTINUE
361.         WRITE(  6,91020)
362. 91020 FORMAT(2X,5(1H-),10X,15(1H-),9X,15(1H-))
363.         CALL EDNUM(16,0,TOTCOS(NY+1),COS1)
364.         CALL EDNUM(16,0,DOTCOS(NY+1),COS2)
365.         WRITE(  6,91030)COS1,COS2
366. 91030 FORMAT(2X,'TOTAL',9X,4A4,8X,4A4)
367.         RETURN
368. 90021 FORMAT(1H )
369. 90222 FORMAT(26X,'--------------- ---------------')
370. 90040 FORMAT(1X,14A4)
371. 90050 FORMAT('0',18X,'TOTAL COST SUMMARY (BY CATEGORY)'/
372.        &                  19X,32(1H-)//
373.        &          28X,'UNDISCOUNTED',4X,'PRESENT VALUE'/
374.        &          28X,'    COST    ',4X,'    COST'/
375.        &          28X,'    ----    ',4X,'    ----'/)
376.         END
377.         SUBROUTINE OUTOP6(CARY,NINC,SUMHLD,IELHLD)
378.         COMMON / PRINT /IPRT(8),STYTL    ,CTIME,CDATE
379.         CHARACTER*8 CTIME,CDATE
380.            CHARACTER*4 STYTL(8)
381.         DIMENSION SUMHLD(500,3),COS1(4),COS2(4)
382.         IF ( IELHLD .EQ. 0 ) WRITE(  6,90000)CARY
383.         IF ( IELHLD .NE. 0 ) WRITE(  6,90020)CARY,IELHLD
384.         DO 100 I = 1 , NINC
385.         CALL EDNUM(16,0,SUMHLD(I,2),COS1)
386.         CALL EDNUM(16,0,SUMHLD(I,3),COS2)
387.         WRITE(  6,90010)SUMHLD(I,1),COS1,COS2
388.   100 CONTINUE
389.         RETURN
390. 90000 FORMAT('1',21X,'SENSITIVITY ANALYSIS'/22X,20(1H-)//
391.        & 5X,'SENSITIVITY'/
392.        & 6X,'PARAMETER',8X,'UNDISCOUNTED',6X,'PRESENT VALUE'/
393.        & 10X,A4,10X,'TOTAL COST',9X,'TOTAL COST'/
394.        & 6X,9(1H-),8X,'------------',6X,'-------------'//)
395. 90010 FORMAT(2X,F13.3,4X,4A4,2X,4A4)
396. 90020 FORMAT('1',21X,'SENSITIVITY ANALYSIS'/22X,20(1H-)//
397.        & 5X,'SENSITIVITY'/
398.        & 6X,'PARAMETER',8X,'UNDISCOUNTED',6X,'PRESENT VALUE'/
399.        & 7X,A4,'(',I2,')',9X,'TOTAL COST',9X,'TOTAL COST'/
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400.        & 6X,9(1H-),8X,'------------',6X,'-------------'//)
401.        END
402.        FUNCTION POISON (LAMBDA,T,NS)
403.        REAL LAMBDA,LT,LOGLT,LOGSN1,LOGSN,LOGTRM
404.        IF ( NS .EQ. 0 ) GO TO 200
405.        T1 = FLOAT(NS)/LAMBDA
406.        LT = LAMBDA*T
407.        POISON  = T-T1+EXP(ALOG(T1)-LT)
408.        IF ( NS .EQ. 1 ) RETURN
409.        NS1 = NS-1
410.        LOGLT = ALOG(LT)
411.        FNS = FLOAT(NS)
412.        LOGSN1 = ALOG(FNS)
413.        LOGTRM = LOGSN1-ALOG(LAMBDA)-LT
414.        DO 100 K = 1,NS1
415.        LOGSN = LOGSN1
416.        LOGSN1 = ALOG(FNS-FLOAT(K))
417.        LOGTRM  = LOGTRM +LOGLT+LOGSN1-LOGSN-ALOG(FLOAT(K))
418.        POISON  = POISON  + EXP(LOGTRM )
419.   100 CONTINUE
420.        RETURN
421.   200 CONTINUE
422.        POISON  = T
423.        RETURN
424.        END
425.        SUBROUTINE PRBSPR(NSYS,ICONUS)
426.        COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
427.        &          MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
428.        &          RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
429.        &          LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
430.        &          USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
431.        REAL NRTS,NRTS2,MTBF
432.        CHARACTER*4 ANAME,COS
433.        COMMON / SPRDAT /NRS(500),SRUS(500),LRUS(500),SRUMAX, LRUMAX,
434.        &               NRS2(500)
435.        INTEGER SRUS, SRUMAX
436.        COMMON / SYSBAS /NALCC(400), IALCC(400), NALCO(400),IALCO(400),
437.        &               NSC, NSO
438.        COMMON / BSPR /BLAMDA (500),BT(500),NSB(500)
439.        DIMENSION COS(4), NALC(400,2)
440.        EQUIVALENCE (NALC,NALCC)
441.        INTEGER SRUDEX
442.        NBASE = NALC(NSYS,ICONUS)
443.        IF(ICONUS.EQ.2 .OR. ICONUS.EQ.4) GO TO 150
444.        WRITE(  6,90010)NSYS,NBASE
445.        DO 100 LRUDEX = 1,LRUMAX
446.        IDEX = LRUS(LRUDEX)
447.        ITEMP = NSB(IDEX)*NBASE
448.        CALL EDNUM(14,0,CRU(IDEX)*ITEMP,COS)
449.        WRITE(  6,90020)(ANAME(IDEX,K),K=1,5),NSB(IDEX),ITEMP,COS
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450.     100 CONTINUE
451.         GO TO 300
452.     150 IF ( SRUMAX .EQ. 0 ) GO TO 300
453.         WRITE(  6,90030)
454.         DO 200 SRUDEX = 1,SRUMAX
455.         IDEX = SRUS(SRUDEX)
456.         ITEMP = NSB(IDEX)*NBASE
457.         CALL EDNUM(14,0,CRU(IDEX)*ITEMP,COS)
458.         WRITE(  6,90020)(ANAME(IDEX,K),K=1,5),NSB(IDEX),ITEMP,COS
459.     200 CONTINUE
460.     300 CONTINUE
461.         WRITE(  6,90040)
462.         RETURN
463.   90010 FORMAT(/3X,I3,6X,I3,11X,'LRU SPARES REQUIREMENTS'/
464.       &         26X,23(1H-)//17X,'REPLACEABLE UNIT',
465.       &         4X,'SPARES/BASE   TOTAL        COST'/
466.       &         17X,16(1H-),4X,11(1H-),2X,5(1H-),7X,4(1H-))
467.   90020 FORMAT(16X,5A4,5X,I3,6X,I4,2X,3A4,A2)
468.   90030 FORMAT(//26X,'SRU SPARES REQUIREMENTS'/26X,23(1H-)//
469.       &         17X,'REPLACEABLE UNIT',
470.       &         4X,'SPARES/BASE   TOTAL        COST'/
471.       &         17X,16(1H-),4X,11(1H-),2X,5(1H-),7X,4(1H-))
472.   90040 FORMAT(1H )
473.         END
474.         SUBROUTINE PRNTMP
475.         COMMON / MANPWR   /FLMH(25), BLMH(25), DLMH(25)
476.         COMMON / PRINT /IPRT(8),STYTL   ,CTIME,CDATE
477.         CHARACTER*8 CTIME,CDATE
478.           CHARACTER*4 STYTL(8)
479.         COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
480.       &                RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
481.       &                AO2, DSSF, NIS
482.         INTEGER WP
483.         WRITE(   6,95000)(STYTL(I),I=1,8),CTIME,CDATE
484.   95000 FORMAT('1',10X,8A4,2(3X,A8))
485.         WRITE(  6,90000)
486.         DO 10 K = 1,NY
487.         WRITE(  6,90010)K,FLMH(K),BLMH(K),DLMH(K)
488.      10 CONTINUE
489.   90000 FORMAT('0',19X,'MANPWR   REQUIREMENTS'/21X,'(MANHOURS PER YEAR)'//
490.       &         1X,'YEAR',9X,'FLIGHT LINE',7X,'BASE',10X,'DEPOT'/
491.       &         1X,'----',9X,'-----------',7X,'----',10X,'-----')
492.   90010 FORMAT(2X,I2,12X,F6.0,2(9X,F6.0))
493.         RETURN
494.         END
495.         SUBROUTINE READA
496.         COMMON / BLK A /SIE, SBR, SDR, SDR2, SPSC, SPSO, SID, SIM,
497.       &                SDM, SBMC, SDMC, SDC2, DF
498.         READ( 5,90000)SIE, SBR, SDR, SDR2, SPSC, SPSO, SID, SIM,
499.       &                SDM, SBMC, SDMC, SDC2, DF
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500.   90000 FORMAT(13F6.0)
501.         RETURN
502.         END
503.         SUBROUTINE READB
504.         COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
505.       &               RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
506.       &               AO2, DSSF, NIS
507.         INTEGER WP
508.         COMMON / ACTSCH /NAC(12,25), NCUM(12,25),  MACDEX
509.         COMMON / SYSBAS /NALCC(400), IALCC(400), NALCO(400),IALCO(400),
510.       &               NSC, NSO
511.         DIMENSION NACEQ(300), NCUMEQ(300)
512.         EQUIVALENCE (NACEQ,NAC), (NCUMEQ,NCUM)
513.         DO 3 M=1,300
514.       3 NACEQ(M) = 0
515.         DO 10 M=1,400
516.         NALCC(M) = 0
517.         NALCO(M) = 0
518.         IALCC(M) = 0
519.         IALCO(M) = 0
520.      10 CONTINUE
521.         READ( 5,90001)NY,NBC,NIC,NBO,NIO,NSC,NSO
522.         IF ( NBC .EQ. 0) GO TO 25
523.         IBTOT = 0
524.         ISTOT = 0
525.      20 READ( 5,90002)NBASE,NSYS
526.         IBTOT = IBTOT + NBASE
527.         ISTOT = ISTOT + NSYS*NBASE
528.         IF ( NALCC(NSYS) .NE. 0 ) WRITE(6,111) NSYS
529.         NALCC(NSYS) = NBASE
530.         IF ( IBTOT.EQ.NBC .AND. ISTOT.EQ.NSC ) GO TO 25
531.         IF ( IBTOT.GE.NBC .OR. ISTOT.GE.NSC ) WRITE(6,121)
532.         GO TO 20
533.      25 IBTOT = 0
534.         ISTOT = 0
535.         IF(NIC.EQ.0) GO TO 29
536.      27 READ( 5,90002) ISITE,ISYS
537.         IBTOT=IBTOT+ISITE
538.         ISTOT=ISTOT+ISYS*ISITE
539.         IF(IALCC(ISYS) .NE. 0) WRITE(6,111) NSYS
540.         IALCC(ISYS)=ISITE
541.         IF(IBTOT.EQ.NIC .AND. ISTOT.EQ.NSC) GO TO 29
542.         IF(IBTOT.GE.NIC .OR. ISTOT.GE.NSC) WRITE(6,126)
543.         GO TO 27
544.      29 IBTOT = 0
545.         ISTOT = 0
546.         IF ( NBO .EQ. 0 ) GO TO 35
547.      30 READ( 5,90002)NBASE,NSYS
548.         IBTOT = IBTOT + NBASE
549.         ISTOT = ISTOT + NSYS*NBASE
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550.          IF ( NALCO(NSYS) .NE. 0 ) WRITE(6,131) NSYS
551.          NALCO(NSYS) = NBASE
552.          IF ( IBTOT.EQ.NBO .AND. ISTOT.EQ.NSO ) GO TO 35
553.          IF ( IBTOT.GE.NBO .OR. ISTOT.GE.NSO ) WRITE(6,141)
554.          GO TO 30
555.       35 IBTOT = 0
556.          ISTOT = 0
557.          IF(NIO.EQ.0) GO TO 40
558.       37 READ( 5,90002) ISITE,ISYS
559.          IBTOT=IBTOT+ISITE
560.          ISTOT=ISTOT+ISYS*ISITE
561.          IF(IALCO(ISYS) .NE. 0) WRITE(6,131) NSYS
562.          IALCO(ISYS)=ISITE
563.          IF(IBTOT.EQ.NIO .AND. ISTOT.EQ.NSO) GO TO 40
564.          IF(IBTOT.GE.NIO .OR. ISTOT.GE.NSO) WRITE(6,146)
565.          GO TO 37
566.       40 READ( 5,90003)SIN, OH, NDS, NIS, RSTC, RSTO, DMC, DRC, BDSC,
567.          &              BDSO, TAT, WP, ISP, A01, A02, DSSF
568.       50 READ( 5,90004)I,J,NACT
569.          IF ( I .EQ. 0 .AND. J .EQ. 0 ) GO TO 55
570.          IF (I.LE.0.OR.I.GT.NY.OR.J.LE.0.OR.J.GT.12 ) WRITE(6,161)I,J,NACT
571.          NAC(J,I) = NACT
572.          GO TO 50
573.       55 CONTINUE
574.          NCUMEQ(1) = NACEQ(1)
575.           MACIVE = 0
576.          IF ( NACEQ(1) .LT. 0 ) WRITE(6,171)
577.          LIM = NY * 12
578.           MACDEX = 1
579.          DO 5 I = 2,LIM
580.          IF ( NACEQ(I) .LT. 0 .AND.  MACIVE .EQ. 0 ) WRITE(6,171)
581.          NCUMEQ(I) = NCUMEQ(I-1) + NACEQ(I)
582.          IF ( NCUMEQ(I) .GT. NSC+NSO ) WRITE(6,191) I
583.          IF ( NCUMEQ(I) .NE. NSC+NSO ) GO TO 5
584.          IF (  MACIVE .EQ. 0 )  MACDEX = I
585.           MACIVE = 1
586.        5 CONTINUE
587.          IF (  MACIVE .EQ. 0 ) WRITE(6,181)
588.          RETURN
589.      111 FORMAT(' ***ERROR...DUPLICATE CONUS SYSTEM ALLOCATION',I8)
590.      121 FORMAT (' ***ERROR...INCONSISTENT CONUS BASE/SYSTEM ALLOCATION')
591.      126 FORMAT (' ***ERROR...INCONSISTENT CONUS I-LEVEL SITE/SYSTEM ALLOCA
592.          &TION')
593.      131 FORMAT (' ***ERROR...DUPLICATE OVERSEAS SYSTEM ALLOCATION',I8)
594.      141 FORMAT (' ***ERROR..INCONSISTENT OVERSEAS BASE/SYSTEM ALLOCATION')
595.      146 FORMAT (' ***ERROR..INCONSISTENT OVERSEAS I-LEVEL SITE/SYSTEM ALLO
596.          &CATION')
597.      161 FORMAT (' ***ERROR...INVALID ACTIVATION SCHEDULE INPUT',3I8)
598.      171 FORMAT (' ***ERROR...DEACTIVATION BEFORE FULL ACTIVATION')
599.      181 FORMAT (' ***ERROR...FULL ACTIVATION NOT REACHED')
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600.      191 FORMAT (' ***ERROR...TOO MANY SYSTEMS ACTIVE IN MONTH',I5)
601.    90001 FORMAT(5I4,2I5)
602.    90002 FORMAT(2I4)
603.    90003 FORMAT(F 8.0,F6.0,2I2,7F6.0,I3,I2,2F4.3,F5.4)
604.    90004 FORMAT(2I3,I5)
605.          END
606.          SUBROUTINE READC
607.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
608.        &            MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
609.        &              RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
610.        &              LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
611.        &              USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
612.          REAL NRTS,NRTS2,MTBF
613.            CHARACTER*4 ANAME
614.          READ( 5,90000)NRU
615.          DO 10 I=1,NRU
616.          READ( 5,90010)(ANAME(I,J),J=1,5),LV2(I),LR2(I)
617.          READ( 5,90020)LN(I), IN(I), NQ(I), CRU(I), MTBF(I), UFP(I), W(I),
618.        &               FVS(I), RLS(I), RRS(I), RMS(I), NRTS(I), COND(I),
619.        &               LV(I), LSEV(I), USEV(I), LR(I), (LSER(I,J),J=1,4),
620.        &               (USER(I,J),J=1,4)
621.          IF(LV2(I).EQ.0) LV2(I)=LV(I)
622.          IF(LR2(I).EQ.0) LR2(I)=LR(I)
623.       10 CONTINUE
624.          RETURN
625.    90000 FORMAT( )
626.    90010 FORMAT(5A4,28X,I2,5X,I2)
627.    90020 FORMAT (I3,I1,I2,2F6.0,F3.3,4F4.0,F5.0,2F3.3,2I2,F3.0,5I2,4F3.0)
628.          END
629.          SUBROUTINE READD
630.            CHARACTER*4 ANSE(40,5)
631.          COMMON / BLK D /NSE, LSE(40), ANSE        , CSE(40), COM(40)
632.          READ( 5,90000)NSE
633.          DO 10 J=1,NSE
634.          READ( 5,90010)(ANSE(J,K),K=1,5)
635.          READ( 5,90020)LSE(J),CSE(J),COM(J)
636.       10 CONTINUE
637.          RETURN
638.    90000 FORMAT(I2)
639.    90010 FORMAT(5A4)
640.    90020 FORMAT(I2,F7.0,F5.0)
641.          END
642.          SUBROUTINE READE
643.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
644.        &                 RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
645.        &                 AO2, DSSF, NIS
646.          INTEGER WP
647.          COMMON / BLK E /ACS, BTC, DTC, DCB, DCD, DCO, NPB, NPD, NPO,
648.        &                 NI, CRSC, CRSO, CDMC, WPR
649.          COMMON / RELIAB   /G(26), GR(12,25), GM,ENR(500,25), EPM(25)
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650.          NY1 = NY + 1
651.          READ( 5,90000)ACS,BTC,DTC,DCB,DCD,DCO,NPB,NPD,NPO,NI,CRSC,CRSO,
652.       &            CDMC,WPR
653.          READ ( 5,90010) (G(K),K=1,13)
654.          IF(NY1.GT.13) READ ( 5,90010 ) (G(K),K=14,NY1)
655.          RETURN
656.  90000 FORMAT(F6.0,F5.0,3F6.0,F7.0,2I4,I5,I4,3F6.0,F9.0)
657.  90010 FORMAT(13F6.0)
658.          END
659.          SUBROUTINE SERC
660.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
661.       &            RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
662.       &            AO2, DSSF, NIS
663.          INTEGER WP
664.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
665.       &            MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
666.       &            RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
667.       &            LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
668.       &            USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
669.          REAL NRTS,NRTS2,MTBF
670.            CHARACTER*4 ANAME
671.          COMMON / BLK D /NSE, LSE(40), ANSE(40,5), CSE(40), COM(40)
672.          COMMON / RELIAB   /G(26), GR(12,25), GM,ENR(500,25), EPM(25)
673.          COMMON / SYSBAS /NALCC(400), IALCC(400), NALCO(400),IALCO(400),
674.       &            NSC, NSO
675.          COMMON / SUPDAT /IBREQ(40), IDREQ(40), IBR2(40), IDR2(40)
676.          COMMON ISWTCH
677.          DIMENSION D(40),RBHPM(40),IBREQ2(40),IDREQ2(40)
678.          IBTOT=NBC+NBO
679.          NTOT = NSC + NSO
680.          WHPMAD = (5./7.) * (8.*FLOAT(NDS)/24.) * 730.
681.          GF = GM
682.          IF ( WP .GT. 0 ) GF = G(WP+1)
683.          DO 20 J=1,NSE
684.          IBR2(J)=0
685.          IDR2(J)=0
686.          IBREQ(J)=0
687.          RBHPM(J)=0
688.          D(J)=0.0
689.     20 CONTINUE
690.          DO 1400 I=1,NRU
691.          WHPS=(FLOAT(NQ(I))*OH)/(G(WP+1)*MTBF(I))
692.          IF(LV(I) .GT. 1)GO TO 700
693.          IF(LSEV(I) .EQ. 0)GO TO 250
694.          DO 100 J=1,NSE
695.          IF(LSEV(I) .EQ. LSE(J))GO TO 200
696.    100 CONTINUE
697.          WRITE( 6,90000)LSEV(I),I
698.          PRINT *,'STOP IGNORED*****************'
699.    200 RBHPM(J)=RBHPM(J)+WHPS*USEV(I)
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700.      250 IF(LR(I) .GT. 1)GO TO 1000
701.          DO 500 K=1,4
702.          IF(LSER(I,K) .EQ. 0)GO TO 600
703.          DO 300 J=1,NSE
704.          IF(LSER(I,K) .EQ. LSE(J))GO TO 400
705.      300 CONTINUE
706.          WRITE( 6,90010)LSER(I,K),I
707.          PRINT *,'STOP IGNORED**************2'
708.      400 RBHPM(J)=RBHPM(J)+WHPS*USER(I,K)
709.      500 CONTINUE
710.      600 GO TO 1000
711.      700 IF(LSEV(I) .EQ. 0) GO TO 1000
712.          DO 800 J=1,NSE
713.          IF(LSEV(I).EQ.LSE(J))GO TO 900
714.      800 CONTINUE
715.          WRITE( 6,90000)LSEV(I),I
716.          PRINT *,'STOP IGNORED**************3'
717.      900 D(J) = D(J)+FLOAT(NTOT*NQ(I))*OH*USEV(I)/((1.-UFP(I))*GF*MTBF(I))
718.     1000 DO 1300 K=1,4
719.          IF(LSER(I,K).EQ.0)GO TO 1400
720.          DO 1100 J=1,NSE
721.          IF(LSER(I,K).EQ.LSE(J))GO TO 1200
722.     1100 CONTINUE
723.          WRITE( 6,90010)LSER(I,K),I
724.          PRINT *,'STOP IGNORED**************4'
725.     1200 CONTINUE
726.          FACTOR = NRTS(I)
727.          IF ( LR(I) .GT. 1 ) FACTOR = FACTOR + RTS(I)
728.          D(J) = D(J) + FLOAT(NTOT*NQ(I))*OH*USER(I,K) / (GF*MTBF(I))
729.          &             * FACTOR
730.     1300 CONTINUE
731.     1400 CONTINUE
732.          DO 1420 I=1,400
733.          IF(IALCC(I).EQ.0) GO TO 1420
734.          DO 1415 J=1,NSE
735.          IBREQ(J)=IBREQ(J)+ICEIL((RBHPM(J)*FLOAT(I))/(174.*FLOAT(NIS)))
736.          &*IALCC(I)
737.     1415 CONTINUE
738.     1420 CONTINUE
739.          DO 1450 I=1,400
740.          IF(IALCO(I).EQ.0) GO TO 1450
741.          DO 1445 J=1,NSE
742.          IBREQ(J)=IBREQ(J)+ICEIL((RBHPM(J)*FLOAT(I))/(174.*FLOAT(NIS)))
743.          &*IALCO(I)
744.     1445 CONTINUE
745.     1450 CONTINUE
746.          DO 1500 J=1,NSE
747.          IDREQ(J) = ICEIL(D(J)/WHPMAD)
748.     1500 CONTINUE
749.          IF(ISWTCH) 1700,2000,1600
```

```
750.   1600 DO1610 J=1,NSE
751.        IDREQ2(J)=IDREQ(J)
752.        IBREQ2(J)=IBREQ(J)
753.   1610 CONTINUE
754.        GO TO 2000
755.   1700 DO 1710 J=1,NSE
756.        IF(IDREQ2(J).LT.IDREQ (J)) IDR2(J)=IDREQ(J)-IDREQ2(J)
757.        IF(IBREQ2(J).LT.IBREQ (J)) IBR2(J)=IBREQ(J)-IBREQ2(J)
758.        IF(IDREQ2(J).GT.IDREQ(J)) IDREQ(J)=IDREQ2(J)
759.        IF(IBREQ2(J).GT.IBREQ(J)) IBREQ(J)=IBREQ2(J)
760.   1710 CONTINUE
761.   2000 RETURN
762.  90000 FORMAT(1H1,1X,'SUPPORT ITEM',I3,1X,'VERIFYING LINE ITEM',I3,
763.        & 1X,'NOT FOUND')
764.  90010 FORMAT(1H1,1X,'SUPPORT ITEM',I3,1X,'REPAIRING LINE ITEM',I3,
765.        & 1X,'NOT FOUND')
766.        END
767.        SUBROUTINE SET(VAL,ICOMN,IOFF,ITYPE,MODE)
768.        COMMON /BLKA/OLAY1(13)
769.        COMMON /BLKB/OLAY2(21)
770.        COMMON /BLKC/OLAY3(1751)
771.        COMMON /BLKD/OLAY4(81)
772.        COMMON /BLKE/OLAY5(14)
773.        COMMON /RELIAB /OLAY6(1602)
774.        DIMENSION ILAY1(13),ILAY2(21),ILAY3(1701),ILAY4(81),ILAY5(14),
775.        &          ILAY6(1602)
776.        DIMENSION IN(500),CRU(500),TBF(500)
777.        EQUIVALENCE (ILAY3(1),NRU)
778.        EQUIVALENCE (OLAY3(402),CRU(1)),
779.        &           (OLAY3(452),TBF(1)),
780.        &           (OLAY3(52),IN(1)),
781.        &           (OLAY5(1),AC5)
782.        EQUIVALENCE (OLAY1(1),ILAY1(1)),
783.        &           (OLAY2(1),ILAY2(1)),
784.        &           (OLAY3(1),ILAY3(1)),
785.        &           (OLAY4(1),ILAY4(1)),
786.        &           (OLAY5(1),ILAY5(1)),
787.        &           (OLAY6(1),ILAY6(1))
788.        IF ( ICOMN .NE. 3 ) GO TO 90
789.        IF ( MODE .NE. 1 ) GO TO 90
790.        IF ( (IOFF.GE.402) .AND. (IOFF.LE.451) ) GO TO 600
791.        IF ( (IOFF.GE.452) .AND. (IOFF.LE.501) ) GO TO 700
792.     90 GO TO (100,200,300,400,500,550),ICOMN
793.    100 IF(MODE.EQ.1)GO TO 120
794.        VAL = OLAY1(IOFF)
795.        RETURN
796.    120 IF(ITYPE.EQ.1)GO TO 130
797.        OLAY1(IOFF)=VAL
798.        RETURN
799.    130 ILAY1(IOFF)=IFIX(VAL)
```

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800.          RETURN
801.      200 IF(MODE.EQ.1)GO TO 220
802.          VAL = OLAY2(IOFF)
803.          RETURN
804.      220 IF(ITYPE.EQ.1)GO TO 230
805.          OLAY2(IOFF)=VAL
806.          RETURN
807.      230 ILAY2(IOFF)=IFIX(VAL)
808.          RETURN
809.      300 IF(MODE.EQ.1)GO TO 320
810.          VAL = OLAY3(IOFF)
811.          RETURN
812.      320 IF(ITYPE.EQ.1)GO TO 330
813.          OLAY3(IOFF)=VAL
814.          RETURN
815.      330 ILAY3(IOFF)=IFIX(VAL)
816.          RETURN
817.      400 IF(MODE.EQ.1)GO TO 420
818.          VAL = OLAY4(IOFF)
819.          RETURN
820.      420 IF(ITYPE.EQ.1)GO TO 430
821.          OLAY4(IOFF)=VAL
822.          RETURN
823.      430 ILAY4(IOFF)=IFIX(VAL)
824.          RETURN
825.      500 IF(MODE.EQ.1)GO TO 520
826.          VAL = OLAY5(IOFF)
827.          RETURN
828.      520 IF(ITYPE.EQ.1)GO TO 530
829.          OLAY5(IOFF)=VAL
830.          RETURN
831.      530 ILAY5(IOFF)=IFIX(VAL)
832.          RETURN
833.      550 IF(MODE.EQ.1)GO TO 560
834.          VAL = OLAY6(IOFF)
835.          RETURN
836.      560 IF(ITYPE.EQ.1)GO TO 570
837.          OLAY6(IOFF)=VAL
838.          RETURN
839.      570 ILAY6(IOFF)=IFIX(VAL)
840.          RETURN
841.      600 CONTINUE
842.          OLDV = OLAY3(IOFF)
843.          RATIO = VAL/OLDV
844.          DIFF = OLDV - VAL
845.          ITEM = IOFF + 1 - 402
846.          IND1 = IN(ITEM)
847.          IF ( ITEM .LT. 2 ) GO TO 615
848.          DO 610 I = 2 , ITEM
849.          J = ITEM - I + 1
```

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850.          IND = IN(J) + 1
851.          IF ( IND1 .NE. IND ) GO TO 610
852.          IND1 = IND - 1
853.          CRU(J) = CRU(J) - DIFF
854.     610 CONTINUE
855.     615 CONTINUE
856.          IND = IN(ITEM)
857.          DO 620 J = ITEM , NRU
858.          IF ( (IND.EQ.IN(J)) .AND. (J.NE.ITEM) ) GO TO 630
859.          CRU(J) = CRU(J) * RATIO
860.     620 CONTINUE
861.     630 ACS=CRU(1)
862.          RETURN
863.     700 CONTINUE
864.          OLDV = 1./OLAY3(IOFF)
865.          RATIO = (1./VAL)/OLDV
866.          DIFF =OLDV - 1./VAL
867.          ITEM = IOFF + 1 - 452
868.          IND1 = IN(ITEM)
869.          IF ( ITEM .LT. 2 ) GO TO 715
870.          DO 710 I = 2 , ITEM
871.          J = ITEM - I + 1
872.          IND = IN(J) + 1
873.          IF ( IND1 .NE. IND ) GO TO 710
874.          IND1 = IND-1
875.          TBF(J) = 1./(1./TBF(J) - DIFF)
876.     710 CONTINUE
877.     715 CONTINUE
878.          IND = IN(ITEM)
879.          DO 720 J = ITEM , NRU
880.          IF ( (IND.EQ.IN(J)) .AND. (J.NE.ITEM) ) GO TO 730
881.          TBF(J) = 1./((1./TBF(J)) * RATIO)
882.     720 CONTINUE
883.     730 RETURN
884.          END
```

```
1.          SUBROUTINE SREQ
2.          COMMON / SPRDAT /NRS(500),SRUS(500),LRUS(500),SRUMAX, LRUMAX,
3.        &                NRS2(500)
4.          INTEGER SRUS, SRUMAX
5.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
6.        &            MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
7.        &            RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
8.        &            LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
9.        &            USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
10.         REAL NRTS,NRTS2,MTBF
11.         COMMON / PRINT /IPRT(8),STYTL    ,CTIME,CDATE
12.         CHARACTER*8 CTIME,CDATE
13.             CHARACTER*4 STYTL(8),ANAME,ANSE(40,5),COS
14.         COMMON / DSPR /DLAMDA(500),DT(500),NSD(500)
15.         COMMON / BSPR /BLAMDA (500),BT(500),NSB(500)
16.         COMMON / SYSBAS /NALCC(400), IALCC(400), NALCO(400),IALCO(400),
17.       &                NSC, NSO
18.         COMMON / CSPR / NCS(500)
19.         DIMENSION COS(4),NSD2(500),NCS2(500),NSBC2(50 ,500),NSBO2(50 ,500)
20.         DIMENSION ISBC2(50 ,500),ISBO2(50 ,500)
21.         COMMON ISWTCH
22.         CALL DSPARE
23.         IF ( IPRT(3) .NE. 1 .OR. ISWTCH.GT.0 ) GO TO 50
24.         WRITE(   6,95000)(STYTL(I),I=1,8),CTIME,CDATE
25. 95000 FORMAT('1',10X,8A4,2(3X,A8))
26.         WRITE(   6,90010)
27.    50 DO 300 I = 2,NRU
28.         IF(ISWTCH) 200,250,100
29.   100 NSD2(I)=NSD(I)
30.         GO TO 300
31.   200 NRS2(I)=0
32.         IF(NSD(I).LE.NSD2(I)) GO TO 240
33.         NRS2(I)=NSD(I)-NSD2(I)
34.         GO TO 250
35.   240  NSD(I)=NSD2(I)
36.   250 IF(IPRT(3).NE.1) GO TO 300
37.         CALL EDNUM(16,0,CRU(I)*NSD(I),COS)
38.         WRITE(   6,90020)(ANAME(I,K),K=1,5),NSD(I),COS
39.   300 NRS(I) = NSD(I)
40.         CALL BSINIT
41.         IF ( IPRT(3) .EQ. 1 .AND. ISWTCH.LE.0) WRITE ( 6,90030)
42.         IM=0
43.         DO 400 M = 1,400
44.         MX = M
45.         IF ( NALCC(M) .EQ. 0 ) GO TO 400
46.         IM = IM + 1
47.         CALL BSPARE(MX,1)
48.         DO 350 I = 2,NRU
49.         IF(ISWTCH) 325,350,310
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50.    310 NSBC2(IM,I)=NSB(I)
51.        GO TO 350
52.    325 IF(NSBC2(IM,I).GE.NSB(I)) GO TO 330
53.        NRS2(I)=NRS2(I)+NSB(I)-NSBC2(IM,I)
54.        GO TO 350
55.    330 NSB(I)=NSBC2(IM,I)
56.    350 NRS(I)=NRS(I)+NSB(I)*NALCC(M)
57.        IF(IPRT(3).EQ.1 .AND. ISWTCH.LE.0) CALL PRBSPR(MX,1)
58.    400 CONTINUE
59.        IM=0
60.        DO 440 M=1,400
61.        MX = M
62.        IF ( IALCC(M) .EQ. 0 ) GO TO 440
63.        IM=IM+1
64.        CALL BSPARE(MX,2)
65.        DO 430 I = 2,NRU
66.        IF(IN(I).EQ.2) GO TO 430
67.        IF(ISWTCH) 425,430,410
68.    410 ISBC2(IM,I)=NSB(I)
69.        GO TO 430
70.    425 IF(ISBC2(IM,I).GE.NSB(I)) GO TO 427
71.        NRS2(I)=NRS2(I)+NSB(I)        -ISBC2(IM,I)
72.        GO TO 430
73.    427 NSB(I)=ISBC2(IM,I)
74.    430 NRS(I)=NRS(I)+NSB(I)*IALCC(M)
75.        IF (IPRT(3) .EQ. 1.AND.ISWTCH.LE.0) CALL PRBSPR(MX,2)
76.    440 CONTINUE
77.        IF (IPRT(3) .EQ. 1.AND.ISWTCH.LE.0) WRITE ( 6,90040)
78.        IM=0
79.        DO 500 M = 1,400
80.        MX = M
81.        IF ( NALCO(M) .EQ. 0 ) GO TO 500
82.        IM = IM+1
83.        CALL BSPARE(MX,3)
84.        DO 450 I=2,NRU
85.        IF(ISWTCH) 445,450,442
86.    442 NSBO2(IM,I)=NSB(I)
87.        GO TO 450
88.    445 IF(NSBO2(IM,I).GE.NSB(I)) GO TO 447
89.        NRS2(I)=NRS2(I)+NSB(I)-NSBO2(IM,I)
90.        GO TO 450
91.    447 NSB(I)=NSBO2(IM,I)
92.    450 NRS(I) = NRS(I) + NSB(I)*NALCO(M)
93.        IF (IPRT(3) .EQ. 1 .AND. ISWTCH.LE.0) CALL PRBSPR(MX,3)
94.    500 CONTINUE
95.        IM=0
96.        DO 550 M=1,400
97.        MX = M
98.        IF (IALCO(M) .EQ. 0 ) GO TO 550
99.        IM=IM+1
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100.         CALL BSPARE (MX,4)
101.         DO 540 I=2,NRU
102.         IF (IN(I).EQ.2) GO TO 540
103.         IF (ISWTCH) 525,540,510
104.    510 ISBO2(IM,I)=NSB(I)
105.         GO TO 540
106.    525 IF(ISBO2(IM,I).GE.NSB(I)) GO TO 530
107.         NRS2(I)=NRS2(I)+NSB(I)-ISBO2(IM,I)
108.         GO TO 540
109.    530 NSB(I)=ISBO2(IM,I)
110.    540 NRS(I)=NRS(I)+NSB(I)*IALCO(M)
111.         IF (IPRT(3).EQ. 1.AND.ISWTCH.LE.0) CALL PRBSPR(MX,4)
112.    550 CONTINUE
113.         CALL CSPARE
114.         IF ( IPRT(3) .NE. 1 .OR. ISWTCH.EQ.1) GO TO 700
115.         WRITE(    6,95000)(STYTL(I),I=1,8),CTIME,CDATE
116.         WRITE(  6,90050)
117.         DO 600 I = 2,NRU
118.         CALL EDNUM(16,0,CRU(I)*NCS(I),COS)
119.         WRITE(  6,90020)(ANAME(I,K),K=1,5),NCS(I),COS
120.    600 CONTINUE
121.    700 CONTINUE
122.         DO 800 I = 2,NRU
123.         IF(ISWTCH.EQ.1) NCS2(I)=NCS(I)
124.         IF(ISWTCH.EQ.-1 .AND. NCS2(I).GT.NCS(I)) NCS(I)=NCS2(I)
125.         NRS(I) = NRS(I) + NCS(I)
126.    800 CONTINUE
127.         RETURN
128. 90010 FORMAT('0',18X,'SPARES REQUIREMENTS (DETAILED)'/19X,30(1H-)//
129.       &        19X,'DEPOT LEVEL SPARES REQUIREMENTS'/19X,31(1H-)//
130.       &        4X,'REPLACEABLE UNIT',11X,'SPARES',20X,'COST'/
131.       &        4X,'----------------',11X,'------',20X,'----'/)
132. 90020 FORMAT(1X,5A4,10X,I5,12X,4A4)
133. 90030 FORMAT('1',15X,'BASE LEVEL SPARES REQUIREMENTS (CONUS)'/16X,38
134.       & (1H-)//' SYSTEMS/'/2X,'BASE',5X,'BASES'/2X,'----',5X,'-----')
135. 90040 FORMAT(//16X,'BASE LEVEL SPARES REQUIREMENTS (OVERSEAS)'/
136.       &        16X,41(1H-)//
137.       &        1X,'SYSTEMS/'/2X,'BASE',5X,'BASES'/2X,'----',5X,'-----')
138. 90050 FORMAT('0',18X,'CONDEMNATION SPARES REQUIREMENTS'/19X,32(1H-)//
139.       &        4X,'REPLACEABLE UNIT',11X,'SPARES',20X,'COST'/
140.       &        4X,'----------------',11X,'------',20X,'----'//)
141.         END
142.         SUBROUTINE SUCM(IT)
143.         COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
144.       &                 RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
145.       &                 AO2, DSSF, NIS
146.         INTEGER WP
147.         COMMON / OMCDAT /OM(7,26), DOM(7,26)
148.         COMMON / ACEDAT /AC(9,26), DAC(9,26)
149.         COMMON / COSSUM /TOTACQ(26), TOTOM(26), TOTCOS(26),
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150.        &                    DOTACQ(26), DOTOM(26), DOTCOS(26)
151.        IF(IT.EQ.1)GO TO 2000
152.        DO 100 K=1,26
153.        TOTACQ(K)=0.0
154.        TOTOM(K)=0.0
155.        TOTCOS(K)=0.0
156.  100 CONTINUE
157.        TOTACQ(NY+1)=0.0
158.        TOTOM(NY+1)=0.0
159.        DO 500 K=1,NY
160.        DO 300 I=1,8
161.        TOTACQ(K)=TOTACQ(K)+AC(I,K)
162.  300 CONTINUE
163.        IF(WP.NE.0)TOTACQ(K)=TOTACQ(K)+AC(9,K)
164.        DO 400 I=1,7
165.        TOTOM(K)=TOTOM(K)+OM(I,K)
166.  400 CONTINUE
167.        TOTCOS(K)=TOTACQ(K)+TOTOM(K)
168.  500 CONTINUE
169.        DO 700 I=1,8
170.        AC(I,NY+1)=0.0
171.        DO 600 K=1,NY
172.        AC(I,NY+1)=AC(I,NY+1)+AC(I,K)
173.  600 CONTINUE
174.  700 CONTINUE
175.        IF(WP.EQ.0)GO TO 720
176.        AC(9,NY+1)=0.0
177.        DO 710 K=1,NY
178.        AC(9,NY+1)=AC(9,NY+1)+AC(9,K)
179.  710 CONTINUE
180.  720 CONTINUE
181.        DO 800 K=1,NY
182.        TOTACQ(NY+1)=TOTACQ(NY+1)+TOTACQ(K)
183.  800 CONTINUE
184.        DO 1000 I=1,7
185.        OM(I,NY+1)=0.0
186.        DO 900  K=1,NY
187.        OM(I,NY+1)=OM(I,NY+1)+OM(I,K)
188.  900 CONTINUE
189. 1000 CONTINUE
190.        DO 1100 K=1,NY
191.        TOTOM(NY+1)=TOTOM(NY+1)+TOTOM(K)
192. 1100 CONTINUE
193.        TOTCOS(NY+1)=TOTACQ(NY+1)+TOTOM(NY+1)
194.        RETURN
195. 2000 CONTINUE
196.        DO  2100 K=1,26
197.        DOTACQ(K)=0.0
198.        DOTOM(K)=0.0
199.        DOTCOS(K)=0.0
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200.    2100 CONTINUE
201.         DOTACQ(NY+1)=0.0
202.         DOTOM(NY+1)=0.0
203.         DO 2500 K=1,NY
204.         DO 2300 I=1,8
205.         DOTACQ(K)=DOTACQ(K)+DAC(I,K)
206.    2300 CONTINUE
207.         IF(WP.NE.0)DOTACQ(K)=DOTACQ(K)+DAC(9,K)
208.         DO 2400 I=1,7
209.         DOTOM(K)=DOTOM(K)+DOM(I,K)
210.    2400 CONTINUE
211.         DOTCOS(K)=DOTACQ(K)+DOTOM(K)
212.    2500 CONTINUE
213.         DO 2700 I=1,8
214.         DAC(I,NY+1)=0.0
215.         DO 2600 K=1,NY
216.         DAC(I,NY+1)=DAC(I,NY+1)+DAC(I,K)
217.    2600 CONTINUE
218.    2700 CONTINUE
219.         IF(WP.EQ.0)GO TO 2720
220.         DAC(9,NY+1)=0.0
221.         DO 2710 K=1,NY
222.         DAC(9,NY+1)=DAC(9,NY+1)+DAC(9,K)
223.    2710 CONTINUE
224.    2720 CONTINUE
225.         DO 2800 K=1,NY
226.         DOTACQ(NY+1)=DOTACQ(NY+1)+DOTACQ(K)
227.    2800 CONTINUE
228.         DO 3000 I=1,7
229.         DOM(I,NY+1)=0.0
230.         DO 2900 K=1,NY
231.         DOM(I,NY+1)=DOM(I,NY+1)+DOM(I,K)
232.    2900 CONTINUE
233.    3000 CONTINUE
234.         DO 3100 K=1,NY
235.         DOTOM(NY+1)=DOTOM(NY+1)+DOTOM(K)
236.    3100 CONTINUE
237.         DOTCOS(NY+1)=DOTACQ(NY+1)+DOTOM(NY+1)
238.         RETURN
239.         END
240.         FUNCTION TD(I)
241.         COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
242.        &            MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
243.        &            RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
244.        &            LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
245.        &            USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
246.         REAL NRTS,NRTS2,MTBF
247.         CHARACTER*4 ANAME
248.         COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
249.        &            RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, A01,
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250.        &                AO2, DSSF, NIS
251.        INTEGER WP
252.        COMMON / XVALS /XNRTS(500),XRTS(500),XCOND(500)
253.        XYZ = EDD(I)
254.        WRITE (6,500) I,XNRTS(I),XRTS(I),XYZ,UFP(I),DMC,DRC
255.    500 FORMAT (' ***',I3,6E12.4)
256.        IF ( LV(I) .EQ. 1 .AND. LR(I) .EQ. 1 ) GO TO 100
257.        IF ( LV(I) .EQ. 1 .AND. LR(I) .EQ. 2 ) GO TO 200
258.        IF ( LV(I) .EQ. 2 .AND. LR(I) .EQ. 2 ) GO TO 300
259.        GO TO 400
260.    100 CONTINUE
261.        TD = DRC
262.        RETURN
263.    200 CONTINUE
264.        IF ( (XRTS(I)+XNRTS(I)) .LT. 1.E-7 ) GO TO 400
265.        TD = (XRTS(I)*(DMC+EDD(I))+XNRTS(I)*DRC)/(XRTS(I)+XNRTS(I))
266.        RETURN
267.    300 CONTINUE
268.        IF ( (UFP(I)+XRTS(I)+XNRTS(I)) .LT. 1.E-7 ) GO TO 400
269.        TD = ((UFP(I)+XRTS(I))*DMC+XRTS(I)*EDD(I)+XNRTS(I)*DRC)/
270.        &       (UFP(I)+XRTS(I)+XNRTS(I))
271.        RETURN
272.    400 CONTINUE
273.        TD = 0.
274.        RETURN
275.        END
276.        SUBROUTINE VALID
277.        COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
278.        &           MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
279.        &            RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
280.        &            LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
281.        &           USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
282.        REAL NRTS,NRTS2,MTBF
283.          CHARACTER*4 ANAME
284.        COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
285.        &            RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, A01,
286.        &            AO2, DSSF, NIS
287.        INTEGER WP
288.        IERR = 0
289.        IF ( A01 .GT. 0. .AND. A01 .LT. 1. ) GO TO 100
290.        WRITE (  6,  1)
291.      1 FORMAT (' *****ERROR...SYSTEM AVAILABILITY OBJECTIVE INV')
292.        IERR = 1
293.    100 CONTINUE
294.        IF ( AO2 .GT. 0. .AND. AO2 .LT. 1. ) GO TO 200
295.        WRITE (  6,  2)
296.      2 FORMAT (' *****ERROR...SHOP AVAILABILITY OBJECTIVE INVAL')
297.        IERR = 1
298.    200 CONTINUE
299.        IF ( IN(') .EQ. 1 ) GO TO 300
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300.          WRITE (  6,  3) IN(1)
301.        3 FORMAT  (' *****ERROR...SYSTEM INDENTURE',I5    ,' NOT 1 ')
302.          IERR = 1
303.      300 CONTINUE
304.          IF ( LR(1) .EQ. 0 ) GO TO 400
305.          WRITE (  6,  4) LR(1)
306.        4 FORMAT  (' *****ERROR...SYSTEM REPAIR LEVEL', I5  ,' NE 0')
307.          IERR = 1
308.      400 CONTINUE
309.          DO 1300 I = 1,NRU
310.          IF ( LV(I) .LE. LR(I) .AND. LV(I) .GE. 0) GO TO 500
311.          WRITE (  6,  5) I
312.        5 FORMAT  (' *****ERROR...LV FOR UNIT',I8,' OUT OF RANGE')
313.          IERR = 1
314.      500 CONTINUE
315.          IF ( UFP(I) .GE. 0. .AND. UFP(I) .LT. 1. ) GO TO 600
316.          WRITE (  6,  6) I
317.        6 FORMAT  (' *****ERROR...UFP FOR UNIT',I8,' OUT OF RANGE')
318.          IERR = 1
319.      600 CONTINUE
320.          IF ( COND(I) .GE. 0. .AND. COND(I) .LE. 1. ) GO TO 700
321.          WRITE (  6,  7) I
322.        7 FORMAT  (' *****ERROR...COND FOR UNIT',I8,' OUT OF RANGE')
323.          IERR = 1
324.      700 CONTINUE
325.          IF ( RTS(I) .GE. -0.0001 .AND. RTS(I) .LE. 1.0001 ) GO TO 800
326.          WRITE (  6,  8) I
327.        8 FORMAT  (' *****ERROR...RTS FOR UNIT',I8,' OUT OF RANGE')
328.          IERR = 1
329.      800 CONTINUE
330.          IF ( NRTS(I) .GE. 0. .AND. NRTS(I) .LE. 1. ) GO TO 900
331.          WRITE (  6,  9) I
 32.        9 FORMAT  (' *****ERROR...NRTS FOR UNIT',I8,' OUT OF RANGE')
333.          IERR = 1
334.      900 CONTINUE
335.          IF ( I .EQ. 1 ) GO TO 1300
336.          IF ( IN(I) .GT. 1 ) GO TO 1000
337.          WRITE (  6, 10) I
338.       10 FORMAT  (' *****ERROR...INVALID INDENTURE FOR UNIT',I8)
339.          IERR = 1
340.          GO TO 1300
341.     1000 CONTINUE
342.          IF ( IN(I) .EQ. IN(I-1) ) GO TO 1200
343.          I1 = I-1
344.          DO 1100 J = 1,I1
345.          K = I - J
346.          IF ( IN(I) .EQ. IN(K) + 1 ) GO TO 1200
347.     1100 CONTINUE
348.          WRITE (  6, 11) I
349.       11 FORMAT  (' *****ERROR...INVALID INDENTURE FOR UNIT',I8)
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350.          IERR = 1
351.          GO TO 1300
352.   1200 CONTINUE
353.          IF ( LV(I) .GE. LR(K) ) GO TO 1300
354.          WRITE (  6, 12) I
355.     12 FORMAT  (' *****ERROR...LV INVALID FOR UNIT',I8)
356.          IERR = 1
357.   1300 CONTINUE
358.          IF ( IERR .EQ. 0 ) RETURN
359.          WRITE (  6, 13)
360.     13 FORMAT  (' ***INVALID DATA, ERRONEOUS RESULTS ARE POSSIBLE')
361.          STOP
362.          END
363.          SUBROUTINE WRTA
364.          COMMON / PRINT /IPRT(8),STYTL    ,CTIME,CDATE
365.          CHARACTER*8 CTIME,CDATE
366.              CHARACTER*4 STYTL(8)
367.          COMMON / BLK A /SIE, SBR, SDR, SDR2, SPSC, SPSO, SID, SIM,
368.        &                 SDM, SBMC, SDMC, SDC2, DF
369.          WRITE(   6,95000)(STYTL(I),I=1,8),CTIME,CDATE
370.   95000 FORMAT('1',10X,8A4,2(3X,A8))
371.          WRITE(   6,90000) SIE, SBR, SDR,SDR2, SPSC, SPSO, SID, SIM,
372.        &                 SDM, SBMC, SDMC, SDC2, DF
373.   90000 FORMAT('0',24X ,'STANDARD ELEMENTS FILE'/
374.        &          25X,22(1H-)//
375.        &          18X,'PARAMETER',30X,'VALUE'/18X,9(1H-),30X,5(1H-)/
376.        &          /5X,'SIE:  ITEM ENTRY COST/NEW ITEM',21X,F6.2
377.        &          /5X,'SBR:  BASE LABOR RATE/HOUR',25X,F6.2
378.        &          /5X,'SDR:  DEPOT LABOR RATE/HOUR',24X,F6.2
379.        &          /5X,'SDR2: DEPOT LABOR RATE/HOUR,#2',  21X,F6.2
380.        &          /5X,'SPSC: PACKAGING & SHIPPING COST/LB. - CONUS',8X,F6.2
381.        & /5X,'SPSO: PACKAGING & SHIPPING COST/LB. - OVERSEAS',5X,F6.2
382.        &          /5X,'SID:  INITIAL DATA MGT. COST/COPY/PAGE',15X,F6.4
383.        &          /5X,'SIM:  ITEM MGT. COST/ITEM/YEAR',21X,F6.2
384.        &          /5X,'SDM:  DATA MGT. COST/PAGE/YEAR',21X,F6.2
385.        &          /5X,'SBMC: BASE MATERIAL CONSUMPTION RATE',16X,F5.2
386.        &          /5X,'SDMC: DEPOT MATERIAL CONSUMPTION RATE',15X,F5.2
387.        &          /5X,'SDC2: DEPOT MATERIAL CONSUMPTION RATE,#2',12X,F5.2
388.        &          /5X,'DF:   DISCOUNT FACTOR',27X,F9.2
389.        &          )
390.          RETURN
391.          END
392.          SUBROUTINE WRTB
393.          COMMON / PRINT /IPRT(8),STYTL    ,CTIME,CDATE
394.          CHARACTER*8 CTIME,CDATE
395.              CHARACTER*4 STYTL(8)
396.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
397.        &                 RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
398.        &                 AO2, DSSF, NIS
399.          INTEGER WP
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400.         COMMON / SYSBAS /NALCC(400), IALCC(400), NALCO(400),IALCO(400),
401.       &                NSC, NSO
402.         COMMON / ACTSCH /NAC(12,25), NCUM(12,25),  MACDEX
403.         WRITE(  6,80000)NY,NBC,NIC,NBO,NIO,NSC,NSO
404.         WRITE(  6,90010)
405.         DO 10 I = 1 , 400
406.         IF ( NALCC(I) .EQ. 0 ) GO TO 10
407.         WRITE(  6,90011)NALCC(I),I
408.      10 CONTINUE
409.         WRITE ( 6,90012)
410.         DO 15 I = 1,400
411.         IF(IALCC(I) .EQ. 0) GO TO 15
412.         WRITE(  6,90011)IALCC(I),I
413.      15 CONTINUE
414.         WRITE(  6,90030)
415.         DO 20 I = 1 , 400
416.         IF ( NALCO(I) .EQ. 0 ) GO TO 20
417.         WRITE(  6,90011)NALCO(I),I
418.      20 CONTINUE
419.         WRITE(  6,90032)
420.         DO 25 I = 1,400
421.         IF(IALCO(I) .EQ. 0) GO TO 25
422.         WRITE(  6,90011) IALCO(I),I
423.      25 CONTINUE
424.         WRITE(  6,90000)SIN, OH, NDS,NIS,RSTC,RSTO,DMC,DRC,BDSC,BDSO,
425.       &                TAT, WP, ISP,AO1, AO2,DSSF
426.         WRITE(   6,95000)(STYTL(I),I=1,8),CTIME,CDATE
427. 95000 FORMAT('1',10X,8A4,2(3X,A8))
428.         WRITE(  6,90020)
429.         DO 50 K = 1,NY
430.         DO 30 M = 1,12
431.         IF ( NAC(M,K) .NE. 0 ) GO TO 40
432.      30 CONTINUE
433.         GO TO 50
434.      40 CONTINUE
435.         WRITE(  6,90040)K,(NAC(M,K),M=1,12)
436.      50 CONTINUE
437.         RETURN
438. 80000 FORMAT('1',24X,'LOGISTIC FACTORS FILE'/
439.       &    25X,21(1H-)//
440.       &    18X,'PARAMETER',32X,'VALUE'/18X,9(1H-),32X,5(1H-)//
441.       &    5X,'NY:   OPERATIONAL LIFE OF SYSTEM (YEARS)',11X,I6/
442.       &    5X,'NBC:  NUMBER OF BASES - CONUS',22X,I6/
443.       &    5X,'NIC:  NUMBER OF I-LEVEL SITES - CONUS',14X,I6/
444.       &    5X,'NBO:  NUMBER OF BASES - OVERSEAS',19X,I6/
445.       &    5X,'NIC:  NUMBER OF I-LEVEL SITES - OVERSEAS',11X,I6/
446.       &    5X,'NSC:  NUMBER OF SYSTEMS - CONUS',20X,I6/
447.       &    5X,'NSO:  NUMBER OF SYSTEMS - OVERSEAS',17X,I6/)
448. 90000 FORMAT(//,
449.       &    5X,'SIN:  COST/SYSTEM INSTALLATION',21X,F9.2/
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450.        &  5X,'OH:    SYSTEM OPERATING HOURS/MONTH',17X,F8.1/
451.        &  5X,'NDS:   NUMBER OF DEPOT WORK SHIFTS',23X,I1/
452.        &  5X,'NIS:   NUMBER OF I-LEVEL WORK SHIFTS',21X,I1/
453.        &  5X,'RSTC:  BASE RESUPPLY TIME - CONUS (HOURS)',11X,F7.0/
454.        &  5X,'RSTO:  BASE RESUPPLY TIME - OVERSEAS (HOURS)',8X,F7.0/
455.        &  5X,'DMC:   DEPOT REPLACEMENT CYCLE TIME (HOURS)',9X,F7.0/
456.        &  5X,'DRC:   DEPOT REPAIR CYCLE TIME (HOURS)',14X,F7.0/
457.        &  5X,'BDSC:  SHIPPING TIME TO DEPOT - CONUS (HOURS)',7X,F7.0/
458.        & 5X,'BDSO: SHIPPING TIME TO DEPOT - OVERSEAS (HOURS)',4X,F7.0/
459.        &  5X,'TAT:   BASE TURNAROUND TIME (HOURS)',17X,F7.0/
460.        &  5X,'WP:    SYSTEM WARRANTY PERIOD (YEARS)',15X,I6/
461.        &  5X,'ISP:   INITIAL SUPPORT PERIOD (YEARS)',15X,I6/
462.        &  5X,'AO1:   SPARES OBJECTIVE (SYSTEM)',24X,F6.3/
463.        &  5X,'AO2:   SPARES OBJECTIVE (SHOP)',26X,F6.3/
464.        &  5X,'DSSF: DEPOT STOCK SAFETY FACTOR',24X,F5.2/
465.        &  )
466.  90010 FORMAT(1H0,'NUMBER OF SYSTEMS AT EACH BASE - CONUS'/
467.        & 1X,'NUMBER OF BASES',5X,'SYSTEMS AT BASE')
468.  90011 FORMAT(4X,I5,17X,I4)
469.  90012 FORMAT(1H0,'NUMBER OF SYSTEMS AT EACH I-LEVEL SITE - CONUS'/
470.        & 1X,'NUMBER OF SITES',5X,'SYSTEMS AT SITE')
471.  90020 FORMAT(/,25X,'ACTIVATION SCHEDULE'
472.        &        /,25X,'-------------------'/
473.        &        /,32X,'MONTH'/
474.        &        2X,'YEAR   1     2     3     4     5     6     7     8     9',
475.        &        '   10    11    12'//)
476.  90040 FORMAT(3X,I2,1X,12(I4,1X))
477.  90030 FORMAT(1H0,'NUMBER OF SYSTEMS AT EACH BASE - OVERSEAS'/
478.        & 1X,'NUMBER OF BASES',5X,'SYSTEMS AT BASE')
479.  90032 FORMAT(1H0,'NUMBER OF SYSTEMS AT EACH I-LEVEL SITE -OVERSEAS
480.        &'/,1X,'NUMBER OF SITES',5X,'SYSTEMS AT SITE')
481.        END
482.        SUBROUTINE WRTC
483.        COMMON / PRINT /IPRT(8),STYTL    ,CTIME,CDATE
484.        CHARACTER*8 CTIME,CDATE
485.          CHARACTER*4 STYTL(8)
486.        COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
487.        &        MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
488.        &        RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
489.        &        LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
490.        &        USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
491.        REAL NRTS,NRTS2,MTBF
492.          CHARACTER*4 ANAME,COS1(2),COS2(2)
493.        DIMENSION PUSER(4)
494.        WRITE(   6,95000)(STYTL(I),I=1,8),CTIME,CDATE
495.        WRITE(   6,90000)NRU
496.        DO 100 I=1,NRU
497.        CALL EDNUM(8,0,CRU(I),COS1)
498.        CALL EDNUM(8,0,MTBF(I),COS2)
499.        PUFP = UFP(I) + .000001
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500.        PW = W(I) + .000001
501.        PFVS = FVS(I) + .000001
502.        PRLS = RLS(I) + .000001
503.        PRRS = RRS(I) + .000001
504.        WRITE(  6,90030)LN(I), IN(I), (ANAME(I,J),J=1,5),NQ(I), COS1,COS2,
505.      &            PUFP, PW, PFVS, PRLS, PRRS
506.    100 CONTINUE
507.        WRITE(   6,95000)(STYTL(I),I=1,8),CTIME,CDATE
508. 95000 FORMAT('1',10X,8A4,2(3X,A8))
509.        WRITE(  6,90040)
510.        DO 200 I=1,NRU
511.        CALL EDNUM(6,0,RMS(I),COS1)
512.        PNRTS = NRTS(I) + .000001
513.        PCOND = COND(I) + .000001
514.        PUSEV = USEV(I) + .000001
515.        DO 110 J = 1,4
516.        PUSER(J) = USER(I,J) + .000001
517.    110 CONTINUE
518.        WRITE(  6,90010)LN(I), COS1, PNRTS, PCOND, LV(I), LV2(I),LSEV(I),
519.      &PUSEV,LR(I),LR2(I),(LSER(I,J),J=1,4),(PUSER(J),J=1,4)
520.    200 CONTINUE
521. 90000 FORMAT('0',24X,'HARDWARE DEFINITION FILE'/25X,24(1H-)//
522.      &    1X,'NUMBER OF REPLACEABLE UNITS = ',I2//
523.      &' LN IN    NOMENCLATURE    NQ    CRU    MTBF    UFP    W    FVS',
524.      &' RLS  RRS'/
525.      &' -- --    ------------    --    ---    ----    ---    -    ---',
526.      &' ---  ---'//)
527. 90030 FORMAT(1X,I3,1X,I1,1X,5A4,1X,I2,2A4,1X,2A4,1X,F5.3,1X,F5.1,1X,
528.      &        2F4.1      ,1X,F4.1)
529. 90040 FORMAT(//51X,'LSER',13X,'USER'/
530.      & ' LN    RMS    NRTS  COND LV LV2 LSEV USEV LR LR2  1  2  3  4    1
531.      &  2    3    4'/
532.      & ' --    ---    ----  ---- -- --- ---- ---- -- ---  -  -  -  -    -
533.      &  -    -    -'//)
534. 90010 FORMAT(1X,I3,1X,A4,A2,1X,F5.3,1X,F5.3,2X,I1,2X,I1,3X,I2,2X,
535.      &        F4.1,2X,I1,2X,I1,2X,4(I2,1X),4(1X,F4.1))
536.        RETURN
537.        END
538.        SUBROUTINE WRTD
539.           CHARACTER*4 ANSE(40,5)
540.        COMMON / BLK D /NSE, LSE(40), ANSE      , CSE(40), COM(40)
541.        CHARACTER*4 COS(4)
542.        WRITE(  6,90000)NSE
543.        DO 100 J=1,NSE
544.        CALL EDNUM(14,0,CSE(J),COS)
545.        WRITE(  6,90010)LSE(J),(ANSE(J,K),K=1,5),COS,COM(J)
546.    100 CONTINUE
547.        RETURN
548. 90000 FORMAT('1',13X,'SUPPORT EQUIPMENT DEFINITION FILE'/
549.      &           14X,'---------------------------------'//
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550.        &        1X,'NUMBER OF LINE ITEMS OF SUPPORT EQUIPMENT = ',I2//
551.        &        1X,'LINE NUMBER      NOMENCLATURE       COST(CSE)',
552.        &        '   O&M COST FACTOR(COM)'/
553.        &        1X,'-----------      ------------       --------- ',
554.        &        '   --------------------'//)
555.  90010 FORMAT(5X,I2,7X,5A4,1X,3A4,A2,9X,F5.3)
556.        END
557.        SUBROUTINE WRTE
558.        COMMON / PRINT /IPRT(8),STYTL    ,CTIME,CDATE
559.        CHARACTER*8 CTIME,CDATE
560.        CHARACTER*4 STYTL(8)
561.        COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
562.        &                RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
563.        &                AO2, DSSF, NIS
564.        INTEGER WP
565.        COMMON / BLK E /ACS, BTC, DTC, DCB, DCD, DCO, NPB, NPD, NPO,
566.        &                NI, CRSC, CRSO, CDMC, WPR
567.        COMMON / RELIAB   /G(26), GR(12,25), GM,ENR(500,25), EPM(25)
568.        CHARACTER*4 COS1(4),COS2(4),COS3(4),COS4(4),COS5(4),COS6(4),
569.        *  COS7(4)
570.        CALL EDNUM(14,0,ACS,COS1)
571.        CALL EDNUM(14,0,BTC,COS2)
572.        CALL EDNUM(14,0,DTC,COS3)
573.        CALL EDNUM(14,0,DCB,COS4)
574.        CALL EDNUM(14,0,DCD,COS5)
575.        CALL EDNUM(14,0,DCO,COS6)
576.        CALL EDNUM(16,0,WPR,COS7)
577.        WRITE(   6,95000)(STYTL(I),I=1,8),CTIME,CDATE
578.  95000 FORMAT('1',10X,8A4,2(3X,A8))
579.        WRITE(   6,90000)COS1,COS2,COS3,COS4,COS5,COS6,NPB,NPD,NPO,NI,
580.        &                CRSC,CRSO,CDMC,COS7,(G(K),K=1,NY )
581.        RETURN
582.  90000 FORMAT('0',19X,'CONTRACTOR DATA FILE'/
583.        &           20X,'--------------------'//
584.        &        10X,'PARAMETER',40X,'VALUE'/
585.        &        10X,'---------',40X,'-----'//
586.        &5X,'ACS:  ACQUISITION COST/SYSTEM',20X,3A4,A2/
587.        &5X,'BTC:  BASE LEVEL TRAINING COST',19X,3A4,A2/
588.        &5X,'DTC:  DEPOT LEVEL TRAINING COST',18X,3A4,A2/
589.        &5X,'DCB:  DATA ACQUISITION COST (BASE LEVEL MANUALS)',1X,3A4,A2/
590.        &5X,'DCD:  DATA ACQUISITION COST (DEPOT LEVEL MANUALS)',3A4,A2/
591.        &5X,'DCO:  DATA ACQUISITION COST (OTHER)',14X,3A4,A2/
592.        &5X,'NPB:  PAGES OF DATA (BASE LEVEL MANUALS)',18X,I4/
593.        &5X,'NPD:  PAGES OF DATA (DEPOT LEVEL MANUALS)',17X,I4/
594.        &5X,'NPO:  PAGES OF DATA (OTHER)',31X,I4/
595.        &5X,'NI:   NUMBER OF NEW INVENTORY ITEMS',23X,I4/
596.        &5X,'CRSC: CONTRACTOR BASE RESUPPLY TIME - CONUS',16X,F4.0/
597.        &5X,'CRSO: CONTRACTOR BASE RESUPPLY TIME - OVERSEAS',13X,F4.0/
598.        &5X,'CDMC: CONTRACTOR REPAIR CYCLE TIME',24X,F5.0/
599.        &5X,'WPR:  WARRANTY PRICE',27X,4A4/
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600.          &/5X,'RELIABILITY GROWTH PROFILE'//3(10(1X,F6.2)/))
601.          END
602.          FUNCTION X(I)
603.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
604.       &           MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
605.       &           RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
606.       &           LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
607.       &           USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
608.          REAL NRTS,NRTS2,MTBF
609.              CHARACTER*4 ANAME
610.          COMMON / XVALS /XNRTS(500),XRTS(500),XCOND(500)
611.          IF ( LV(I) .EQ. 1 .AND. LR(I) .EQ. 1 ) X = XNRTS(I)
612.          IF ( LV(I) .EQ. 1 .AND. LR(I) .EQ. 2 ) X = XNRTS(I)+XRTS(I)
613.          IF ( LV(I) .EQ. 2 .AND. LR(I) .EQ. 2 ) X =XNRTS(I)+XRTS(I)+UFP(I)
614.          RETURN
615.          END
616.          SUBROUTINE CCHECK
617.          COMMON / BLK A /SIE, SBR, SDR, SDR2, SPSC, SPSO, SID, SIM,
618.       &           SDM, SBMC, SDMC, SDC2, DF
619.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
620.       &           MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
621.       &           RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
622.       &           LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
623.       &           USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
624.          REAL NRTS,NRTS2,MTBF
625.              CHARACTER*4 ANAME
626.          COMMON ISWTCH
627.          ISWTCH=0
628.          JSDMC=SDMC*100.
629.          JSDC2=SDC2*100.
630.          JSDR=SDR*100.
631.          JSDR2=SDR2*100.
632.          IF(JSDR.NE.JSDR2) GO TO 20
633.          IF(JSDMC.NE.JSDC2) GO TO 20
634.          DO 10 I=1,NRU
635.          IF(LV(I).NE.LV2(I)) GO TO 20
636.          IF(LR(I).NE.LR2(I)) GO TO 20
637.     10 CONTINUE
638.          GO TO 30
639.     20 ISWTCH=1
640.          DO 25 I=1,NRU
641.          IF(LV(I).EQ.1.AND.LV2(I).EQ.2) WRITE(6,40)
642.          IF(LR(I).EQ.1.AND.LR2(I).EQ.2) WRITE(6,40)
643.          IF(IN(I).NE.2) GO TO 25
644.          IF(LV(I).EQ.LV2(I).AND.LR(I).EQ.LR2(I)) GO TO 25
645.          NRTS2(I)=NRTS(I)
646.          NRTS(I)=1.0
647.          COND2(I)=COND(I)
648.          COND(I)=0.0
649.     25 CONTINUE
```

```
650.       30 CONTINUE
651.  **     WRITE (6,50) ISWTCH
652.  ** 50 FORMAT ('    SUBROUTINE CCHECK ....ISWTCH SET TO',I4)
653.          RETURN
654.       40 FORMAT ('    *** SWITCH FROM 3 LEVEL TO 2 LEVEL NOT ALLOWED **')
655.          END
656.          SUBROUTINE COMPOS
657.          COMMON / BLK A /SIE, SBR, SDR, SDR2, SPSC, SPSO, SID, SIM,
658.         &              SDM, SBMC, SDMC, SDC2, DF
659.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
660.         &           MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
661.         &           RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
662.         &           LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
663.         &           USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
664.          REAL NRTS,NRTS2,MTBF
665.            CHARACTER*4 ANAME
666.          SDRT=SDR
667.          SDR=SDR2
668.          SDR2=SDRT
669.          SDMCT=SDMC
670.          SDMC=SDC2
671.          SDC2=SDMCT
672.          DO 10 I=1,NRU
673.          LVTEMP=LV(I)
674.          LRTEMP=LR(I)
675.          LV(I)=LV2(I)
676.          LR(I)=LR2(I)
677.          LV2(I)=LVTEMP
678.          LR2(I)=LRTEMP
679.          IF(IN(I).NE.2) GO TO 10
680.          IF(LV(I).EQ.LV2(I).AND.LR(I).EQ.LR2(I)) GO TO 10
681.          XTEMP=NRTS(I)
682.          NRTS(I)=NRTS2(I)
683.          NRTS2(I)=XTEMP
684.          XTEMP=COND(I)
685.          COND(I)=COND2(I)
686.          COND2(I)=XTEMP
687.       10 CONTINUE
688.          RETURN
689.          END
690.          SUBROUTINE REJECT
691.          COMMON / RELIAB   /G(26), GR(12,25), GM,ENR(500,25), EPM(25)
692.          COMMON / ACTSCH   /NAC(12,25), NCUM(12,25),  MACDEX
693.          COMMON / BLK B /NY, NBC, NIC, NBO, NIO, SIN, OH, NDS, RSTC,
694.         &              RSTO, DMC, DRC, BDSC, BDSO, TAT, WP, ISP, AO1,
695.         &              AO2, DSSF, NIS
696.          INTEGER WP
697.          COMMON / BLK C /NRU,LN(500),IN(500),ANAME(500,5),NQ(500),CRU(500),
698.         &           MTBF(500),UFP(500),W(500),FVS(500),RLS(500),RRS(500),
699.         &           RMS(500),NRTS(500),COND(500),LV(500),LV2(500),
```

```
700.          &                        LSEV(500),USEV(500),LR(500),LR2(500),LSER(500,4),
701.          &                  USER(500,4),RTS(500),LREM(500),NRTS2(500),COND2(500)
702.          REAL NRTS,NRTS2,MTBF
703.              CHARACTER*4 ANAME
704.          WRITE( 6,5)
705.        5 FORMAT(////24X,'LRU OPERATING HOURS AND FAILURES'/
706.          &24X,32(1H-),//' LINE REPLACEABLE UNIT'/' ----',11(1H-),
707.          &1X,'----')
708.          DO 10 I=1,NRU
709.          IF(IN(I).NE.2) GO TO 10
710.          WRITE( 6,20)(ANAME(I,J),J=1,5)
711.          DO 8 K=1,NY
712.          OPHR=0.
713.          DO 6 M=1,12
714.        6 OPHR=OPHR+NCUM(M,K)*OH*NQ(I)
715.          RTOK=ENR(I,K)*UFP(I)
716.          FAIL=ENR(I,K)*(1.-UFP(I))
717.          WRITE( 6,30)K,ENR(I,K),RTOK,FAIL,OPHR
718.        8 CONTINUE
719.       10 CONTINUE
720.       20 FORMAT('0',5A4,' YEAR     REMOVALS      RTOK S     FAILURES',
721.          &'    OP.HOURS'/21X,'----    ',8(1H-),5X,'------    ',8(1H-),
722.          &3X,8(1H-)/)
723.       30 FORMAT(20X,I5,4F11.1)
724.          RETURN
725.          END
```

APPENDIX 3

DEVELOPMENT PHASE OPERATIONAL FACTOR ASSESSMENT

A3.1   Introduction

This appendix contains data generated during our initial approach.
Subsequent to the October request to try to include development costs
into the LCC analyses, it was determined that these costs were unavail-
able. We still wanted to comply with the request so we formulated
the following brief program descriptions and distributed them to
various disciplines within Collins. The minimal objectives were to
develop percentages of a full military design effort, identify risk
areas and recommend corrective action.

The four alternatives, ranging from a full military design program
to a commercial off-the-shelf acquisition were more difficult to
describe than anticipated. We were soon faced with providing a fairly
detailed procurement package (statement of work, specification, and
contract data requirements list) for four alternatives for three types
of equipment in three operating environments and then providing the
funding resources to prepare and compile the bids.

The scope of this study would not accommodate such an effort in order
to comply with a post award request. The revised approach was then
developed.

A3.2   Development Program Definition

In order to delineate the development program differences, five
development programs were described. These programs are as follows:

1. Full military design, development, test and qualification
    program.

    In this alternative, assume that the Air Force Program

A3.2 Development Program Definition (Continued)

Manager elects to procure equipment on the basis of a design specification with appropriate environmental requirements. Further, assume that he imposes the usual array of military specifications for drawings, labeling, reliability/maintainability program, tech pubs, software quality, qualification testing, reliability and maintainability verification, configuration management, etc.

The preferred method to assess these requirements is to delineate the tasks (but not the schedule) necessary to accomplish the requirements.

2. Commercial off-the-shelf equipment with military equivalent test, verification and qualification program.

In this alternative, assume that the Air Force Program Manager elects to procure commercial off-the-shelf equipment with a specification equivalent to the commercial specification. In addition assume that he imposes the usual array of military requirements for all supporting (non-design) functions. The tasks should be the same tasks outlined for alternative 1 but the man hours and risks may change.

3. Commercial off-the-shelf equipment at catalog price with commercial verification and documentation.

In this alternative, assume that the Air Force Program Manager elects to procure commercial off-the-shelf equipment without any additional tasks.

A3.2   Development Program Definition (Continued)

Since the Air Force does not (in general) know the extent
of support functions such as reliability, maintainability,
test and verification, quality program qualification testing,
software quality assurance etc., discuss the extent and
differences in the tasks identified in alternative 1 that
are accomplished on commercial off-the-shelf equipment at
the catalog price.

4. Commercial off-the-shelf equipment to a commercial
    specification with your recommended set of tasks defined
    to attenuate the risks discussed in alternative 3.

    In this alternative, recommend to the Air Force Program
    Manager the program in your discipline that you feel is
    optimum in terms of reduction of risk at the expense of
    development cost to accomplish the recommended tasks.
    For example, in the area of testing, Rockwell-Collins
    may want to recommend that equipment procured for the
    Airborne inhabited fighter environment be tested to
    ascertain the inherent nuclear hardening level of the
    commercial equipment.

    If, in your opinion, this alternative should be addressed
    as 2, namely (a) mature commercial off-the-shelf equipment
    and (b) newly developed commercial off-the-shelf equipment,
    then address these situations as 2 alternatives namely
    4(a) and 4(b).

A3.3   Operational Factor Assessment Instructions

These descriptions should provide sufficient guidelines for each discipline to accomplish the following estimates.

1. List the tasks necessary to fulfill the requirements of a full military specification defined design effort for a:

    · Communication system in a:

        · Airborne inhabited fighter environment

        · Airborne inhabited transport environment

        · Ground fixed environment

    and a:

    · Data processing system such as a computer in the same 3 environments

    and a:

    · Data processing peripherals such as a computer control head.

2. Estimate the man hours to accomplish the tasks.

3. Briefly discuss any risks associated with the program.

4. For alternatives 2, 3, and 4 identify the tasks to be deleted, reduced, or modified and estimate the man hours to accomplish the modified tasks.

5. Briefly discuss any risks associated with the programs defined by the remaining tasks as defined for alternatives 2, 3 and 4.

A3.3   Operational Factor Assessment Instructions (Continued)

For alternative 3, a commercial off-the-shelf system at catalog
price without any added tasks to attenuate risk, be sure to delineate
the tasks within your discipline that are accomplished on commercial
off-the-shelf equipment and are, therefore, a part of the catalog
price. We can only assume that the Air Force Program Manager thinks
he is getting hardware that meets a commercial specification and
has a given form, fit and function.

There is significant range of equipment that has been intentionally
excluded from the definition of the 4 alternatives. That is the
entire range of modification of commercial off-the-shelf equipment
to meet added requirements. The reasons for this exclusion are:

1. Aspects of this will be discussed in the SOW task to
    define the design differences in (a) good commercial
    practices, (b) best commercial practices, (c) ruggedized
    and (d) militarized.

2. We interpret the term "commercial off-the-shelf" to be
    exactly that which does not include design modification
    or even parts substitution.

3. We recognize that modified commercial equipment has
    extensive appeal to both contractors and Air Force
    Program Managers and recommend that RADC initiate a
    follow-on program to investigate this aspect of
    commercial equipment used by the military.

A3.4   Operational Factor Assessment

The reliability, maintainability, technical publications and

quality assurance responses are provided.

A3.4.1 <u>Reliability</u>

The delineation of the tasks and estimates for the man hours and dollars to accomplish those tasks for a communication system consisting of a receiver/transmitter, control and antenna made up of approximately 1800 electrical parts are shown on the following pages.

A3.4.1.1 Risk Assessment

As shown in the attached outline, several full military reliability
program tasks have been deleted in the recommended set of tasks for
the commercial off-the-shelf program (alternative 4). The risks
associated with these deleted tasks are described below.

Task 303 Rel. Qualification Test

A reliability qualification test has been deleted on the assumption
that reliability growth testing will still be conducted on a
significant sample of equipments. The risks associated with this
deletion will vary depending upon the thoroughness of the reliability
growth test. If Rel growth testing is continued until the current
MTBF reaches the required MTBF and if corrective actions are evaluated
with additional test data, there is little need ior conducting a
reliability qualification test after the reliability growth project
test is completed. It is even valid to project expected future
reliability by discounting failures for which corrective action will
prevent recurrence. Success of using "discounting" requires that
the risk associated with such reclassifications is placed upon the
contractor so that the process is not allowed to be a "numbers game"
necessary to pass the test. This may be accomplished by field
reliability guarantees such as an RIW.

Task 204 FMECA

Failure modes and effects analysis is a costly analysis which is a
prime candidate for tailoring. Most military programs indiscriminately
require FMEA even for single LRU communication equipments. Deletion
of FMEA is a cost saving method which can be applied on many programs
with zero risk. Basically, a FMEA should be accomplished for three

A3.4.1.1 Risk Assessment (Continued)

primary reasons: Safety, Input Data for Maintainability tasks such as Test Requirement Documents (TRD's), and to eliminate undesirable failure modes.

If an equipment is safety critical an FMEA should be conducted on a selected basis in conjunction with the safety analysis. The preferred approach here is a top down safety analysis which identifies which areas of an equipment are of sufficient criticality to require a bottom-up FMECA.

Most communication equipments are not safety critical and should not require FMEA unless required for maintenance TRD's. The benefits of performing FMEA to eliminate unwanted failure modes may be significant at a system or subsystem level, but is seldom worthwhile below the LRU level unless the LRU is identified as a safety critical item.

Task 207 Parts Program

Deletion of a Military Parts Control program is a variable risk item. It depends entirely upon how effective the commercial producer's component engineering activity is at controlling parts. For example, if a commercial producer maintains an active component engineering department and has such key elements as an internal preferred parts list, part qualification system and part specification control, there probably will be little risk in deleting parts program from the reliability requirement since parts control is provided as a part of the normal operating procedure.

A3.4.1.1 Risk Assessment (Continued)

Task 203 Rel Predictions

Task 203 has been reduced to include MTBF predictions based upon the parts count method. Stress analysis is performed on a selected basis only. The purpose of stress analysis for the recommended program is to identify overstressed parts and is not intended to provide a refined MTBF prediction. With this change in scope, stress analysis may be deleted on circuits which a cursary review indicates that the possibility of finding overstressed parts is minimal.

Task 104 FRACAS

A formal Failure Reporting and Correcting Action System (FRACAS) has been deleted from the recommended set of tasks. The risk associated with this deletion can vary, depending upon the suppliers internal failure recurrence control procedure. The risk can be reduced to an acceptable level if it is verified that the Design Engineering Organization follows through with corrective action for qualification test failures and reliability engineering monitors burn-in and early field failures as a part of their normal collateral effort.

Task 103 Program Reviews

Deletion of formal program reviews as a reliability program effort can be accomplished with minimal program risk.

Task 201 Reliability Modeling

Reliability modeling can be deleted since the parts count predictions will provide predictions to the SRU level.

ALTERNATE REL PROGRAM OUTLINE

COMMUNICATION SYSTEM

Alternative 1. Full Military Design, Development, Test & Qualification

Tasks, Ref. MIL-STD-785B	Hrs.	$
101 Rel. Prog. Plan	80	
103 Program Reviews	80	
104 FRACAS	250	
201 Reliability Modeling	20	
203 Rel. Predictions		
Initial P.C.	60	
Stress Analysis	600	
204 FMECA (Functional/SRU Level)	200	
207 Parts Program		
Derating Guideline	20	
Component Engineering Effort (MIL-STD-965)	NWD	
301 Environmental Stress Screening		
Plan & Procedure	80	
302 Rel. Development/Growth Test		
Procedures	80	
Monitor Test/FA (3 Months) (20 Fail)	320	
Test Tech. (Environmental	240	
Repairs $200/Failure (20 Fail)		4K
Special Test Equip.		20K
Report	80	
303 Rel. Qual. Test		
Procedure	40	
Monitor Test/FA (15 Fail)	255	
Test Tech.	240	
Repairs (15)		3K
Special T.E.		-
Report	80	
TOTAL	2725	81,750
	2725	$108,750

Alternative 2. Commercial Off-The Shelf with Military Equivalent Test, Verification and Qualification

Tasks, Ref. MIL-STD-785B	Hrs.	$
101 Rel. Program Plan	40	
203 Rel. Predictions		
Initial P.C.	60	
Selected S/A	120	
301 Environmental Stress Screening		
Plan & Procedure	80	
302 Rel. Development/Growth Test		
(Same as Alt. 1)	720	
Less Special Test		24K
303 Rel. Qual. Test		
(Same as Alt. 1)	615	
		3K
	2250	$ 67,500
		27,000
		$ 94,500

<u>Alternative 3.</u> Commercial Off-The-Shelf With Commercial Verification
and Documentation

<u>Tasks, Ref. MIL-STD-785B</u>	<u>Hrs.</u>	<u>$</u>
203 Rel. Predictions		
P.C. Predictions	60	
Selected S/A	120	
302 Rel. Development/Growth Test		
(Same as Alt. 1)	720	
Less Special T.E.		14K
	900	$ 27,000
		14,000
		$ 41,000

Alternative 4. Commercial Off-The-Shelf With Recommended Set of Tasks

Tasks, Ref. MIL-STD-781B		Hrs.	$
101	Rel. Program Plan	40	
203	Rel. Predictions		
	P.C. Pred.	60	
	Selected S/A	120	
301	Environmental Stress Screening		
	Procedure	80	
302	Rel. Development/Growth Test	720	
			14K
		1020	$ 30,600
			14,000
			$ 44,600

A3.4.2 Maintainability

Maintainability Engineering is an important aspect of equipment
design and support. Much similarity exists in the Maintainability
($\underline{M}$) concerns addressed in the design of military and commercial
equipments.

The Air Force realizes the importance of design for Maintainability
as demonstrated by the extensive $\underline{M}$ requirements listed in equipment
specifications as well as by the numerous $\underline{M}$ data items contracted.
These requirements pertain to modularity, test points, repair times,
repair levels, fault detection/isolation, and maintenance safety.
The Air Force ensures the incorporation of such $\underline{M}$ features by
having the contractor provide documentation (such as MTTR predictions,
AAA Reports, Hazard Analyses, ORLA Report) during the design and
perform formal testing (such as $\underline{M}$ demonstrations of repair and BIT
performance) prior to equipment delivery.

Design requirements of commercial equipment are defined by the
manufacturer's Internal Design Guidelines, as well as by customer
specifications (when a customer has contracted the design). Many
commercial $\underline{M}$ Design Requirements/Guidelines are based on military
standards. Incorporation of these parameters into a commercial
design is documented for Internal Product Integrity Reviews and
for customers who are contracting the design. Internal documentation
may not be as extensive or formal as data provided to a contracting
customer. Equipments designed for a customer are likely to have
some features/peculiarities which are of value perhaps only to that
customer and may or may not cause problems for an off-the-shelf
equipment purchaser. In general, it may be found that the customer

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A3.4.2   Maintainability (Continued)

who contracts a commercial design (such as an airframe manufacturer) may also have previous experiences in working on Government contracts such that his specifications are likely to be biased toward a MIL-Standard direction.

This study is looking at alternatives to the full-scale development approach commonly used in Air Force Acquisition Programs. The alternatives addressed below are (1) purchase a new-design off-the-shelf commercial equipment with testing and support documentation performed to military specifications, (2) purchase of a new-design off-the-shelf commercial equipment with available documentation, and (3) purchase of a new-design or mature-design off-the-shelf commercial equipment with our recommended additional data and testing to reduce the risks associated with (2).

The maintainability tasks generally required for each procurement alternate are listed on the following pages. The risks incurred by the Air Force when purchasing commercial off-the-shelf equipment are discussed in detail in the following paragraphs. Also, recommendations for reducing risks are given. The Maintainability effort associated with Air Force purchase of commercial off-the-shelf equipment is quantitatively displayed in Table A4.1. The respective levels of effort for the various supporting data packages are expressed as a percentage of the normal effort expended in the full scale design of military equipment.

New Commercial Equipment with MIL Support Data (Table A4.1, Column 1)
The Air Force can bypass the lengthy equipment development time by purchasing commercial off-the-shelf equipment. The Air Force may

A3.4.2 Maintainability (Continued)

prefer to still specify full MIL supporting data and testing
requirements. Such data and testing may not be as costly and
require as much effort as during a full scale military development
because the data and testing is being performed after the
equipment design when internal documentation is complete. Since
this study addresses only the purchase of off-the-shelf equipment
without modification, the value of the Air Force specified supporting
data and testing is diminished because corrective action indicated
during the testing and data preparation will not be incorporated
into the equipment design. However analyses (such as testability
analysis and repair level analysis) and testing (such as $\underline{M}$
Demonstration and TPS validation/verification) are essential for
tailoring the support items (support equipment, test procedures,
sparing, facilities, manning, safety procedures) to the specified
maintenance concept.

New Commercial Equipment with Available Supporting Data(Table A4.1, Column 2)
Purchasing an off-the-shelf commercial equipment with existing supporting
data allows for lower acquisition cost, but data which is not written
to MIL Specification may not fully access and support the integration
of the equipment into the Air Force application and support scenario.
For example, a maintenance manual may be written for a 2-level maintenance
concept and thus cause problems when used in a 3-level maintenance
scenario. Existing data may recommend and support use of peculiar
support equipment which may not be in the Air Force inventory or may
not even be appropriate for use by the Air Force. The maintenance
skill levels required for accomplishing the procedures in the
maintenance manuals may necessitate additional/special training for

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A3.4.2   Maintainability (Continued)

A.F. technicians at one or more maintenance levels. Since no field

data would be available on a new equipment, the performance of

Built-In Test and the possibility of maintenance problems are not

fully evident to the customer without special testing such as an

M Demonstration.

Mature Commercial Equipment with Recommended Supporting Data (Table A4.1,
Columns 3 and 4)

The risks associated with purchasing off-the-shelf commercial equipment

with only the existing supporting data can be reduced by contracting

for an optimized data package written to MIL Specifications. A test-

ability analysis of the equipment projected into the military maintenance

structure will expose problems with using different support equipment,

different skill levels, different maintenance concept. A Test

Requirement Document (TRD) will provide the detailed performance and

diagnostic test steps which may not be fully documented in a commercial

maintenance manual. Prediction of active repair times and performance

of an M Demonstration will provide manning and equipment availability

information and will point out improper and time-consuming test

methods. A Material and Maintenance Hazard Analysis Report will

provide a summary of hazards categorized by risk and probability of

occurrence, will identify all built-in safety features which reduce/

eliminate the hazards, and will recommend precautions and procedures.

Data written for a mature commercial equipment will be influenced

by available field information regarding repair time, revised test

methods, and additional safety precautions. The Organic Maintenance

approach for commercial equipment requires almost the same data

as in a full MIL Design Program except for the data created solely

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A3.4.2   Maintainability (Continued)

to monitor the design. A Reliability Improvement Warranty (RIW)

approach for commercial equipment is a way of reducing risks without

requiring all of the supporting data discussed above for the Organic

Maintenance approach. Only data for Organizational Level Maintenance

would be required. A comparison of the supporting data requirements

for the Organic and RIW approaches for mature commercial equipment

are shown in Table A4.1.

New Commercial Equipment with Recommended Supporting Data (Table A4.1
Columns 5 and 6)

Customer risks and recommended supporting data are essentially the

same for new commercial equipment as for mature commercial equipment.

However, field performance of a new commercial equipment obviously

will not be available for incorporation into supporting data. The

Organic Maintenance and the RIW approaches are both appropriate for

support of new commercial equipment.

ALTERNATIVE I

MILITARY

Maintainability

Program Plan

Maintenance Concepts

Predictions

    A. Mean Time To Repair (MTTR, Mct and Mmaxct)
    B. Repair Level Analysis ORLA, LOR, GEMM
    C. Apportionments

Testability

    A. Performance Monitoring
    B. Self Test
    C. Built-In-Test
    D. Test Connectors/Test Points
    E. Fault Isolation
    F. ATE Compatible

Maintainability Design Guidelines

    A. Hardware
    B. Safety

Demonstration Test

    A. Physical Test of Hardware

Test Requirement Documents TRDS

    A. System to LRU
    B. LRU to SRU
    C. SRU to Piece Parts

ALTERNATIVE II

COMMERCIAL WITH MILITARY TEST AND QUAL PROGRAM

Maintainability

Program Plan

Maintenance Concept

Predictions

      A. Mean Time To Repair
      B. Maintenance Manhours Per Flight Hour
      C. Average Material Repair Costs

Testability

      A. Performance Monitoring
      B. Self Test
      C. Built-In-Test
      D. Test Connectors/Test Points
      E. Fault Isolation

Maintainability Design Guidelines

      A. Hardware
      B. Safety

Demonstration Test

      A. Analysis
      B. A/C System Test Sequence

ALTERNATIVE III

COMMERCIAL OFF-THE-SHELF

Maintainability

Commercial "Off-the-Shelf" Equipment

This item would be the same as Alternative IV and is discussed
in Alternative IV.

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ALTERNATIVE IV

*RISK ITEMS FOR COMMERCIAL EQUIPMENT IN MILITARY ENVIRONMENT

Maintainability

Program Plan

Maintenance Concept

    A. Define Concept To Be Used By Procurement Agency.

*Predictions

    A. MTTRs and Mmaxct
    B. Repair Level Analysis ORLA, LOR, GEMM
    C. Apportionments

Maintainability Design Guidelines

*Testability

    A. ATE Compatability

*Demonstration

    A. Physical Demonstration

*Test Requirement Documents TRDs

    A. System to LRU
    B. LRU to SRU
    C. SRU to Piece Parts

TABLE A3.1 MAINTAINABILITY EFFORT ON COMMERCIAL OFF-THE-SHELF EQUIPMENT

(% OF EFFORT RELATIVE TO FULL-SCALE MILITARY EQUIPMENT DESIGN)

MAINTAINABILITY ITEMS	NEW DESIGN W/MIL SUPPORTING DATA	NEW DESIGN W/AVAILABLE SUPPORTING DATA ONLY	MATURE DESIGN W/RECOMMENDED DATA		NEW DESIGN W/RECOMMENDED DATA	
			ORGANIC	RIW	ORGANIC	RIW
M PROGRAM PLAN	80	0	80	50	80	50
M̄TTR (O)	60	0	50	50	60	60
MTTR (I)	60	0	50	0	60	0
MTTR (D)	80	0	80	0	80	0
TESTABILITY/BIT (O)	120	0	120	120	120	120
TESTABILITY/BIT (I)	120	0	120	0	120	0
TESTABILITY/BIT (D)	120	0	120	0	120	0
TRD (O)	100	0	80	80	100	100
TRD (I)	100	0	80	0	100	0
TRD (D)	100	0	100	0	100	0
ORLA	50	0	50	0	50	0
M DEMO (O)	100	0	100	100	100	100
M̄ DEMO (I)	100	0	100	0	100	0
T̄PS VAL/VER (D)	100	0	100	0	100	0
M AAA REPORTING	0	0	0	0	0	0
SYSTEM SAFETY PLAN	50	0	50	50	50	50
PRELIM. HAZARD ANALYSIS	0	0	0	0	0	0
BIOMEDICAL REPORT	100	0	80	80	100	100
MAINT. HAZARD ANALYSIS (O)	100	0	80	80	100	100
MAINT. HAZARD ANALYSIS (I)	100	0	80	0	100	0
MAINT. HAZARD ANALYSIS (D)	100	0	80	0	100	0
PROGRAM/DESIGN REVIEWS	40	0	40	40	40	40

A3.4.3 Technical Publications

RADC CONTRACT EFFORT

The objective of this effort is to show the publications department tasks in preparing military and commercial publications/data. This data provides alternatives for an Air Force Program Manager. Four alternatives are presented. A cost comparison estimate is listed.

		COST COMPARISON ESTIMATE
I	FULL MILITARY DESIGN, DEVELOPMENT, TEST AND QUALIFICATION	100%
	A. Bidding	
	B. Military Publication Procedures	
II	COMMERCIAL OFF-THE-SHELF EQUIPMENT WITH MILITARY TEST, VERIFICATION, AND QUALIFICATION PROGRAM	90%
III	COMMERCIAL OFF-THE-SHELF EQUIPMENT WITH COMMERCIAL VERIFICATION AND DOCUMENTATION	70%
	A. Bidding	
	B. Commercial Publication Procedures	
	C. Risks	
IV	COMMERCIAL OFF-THE-SHELF EQUIPMENT TO COMMERCIAL SPECIFICATIONS WITH RECOMMENDED TASKS TO REDUCE RISKS	70 - 85%

PUBLICATIONS/DATA

I FULL MILITARY DESIGN, DEVELOPMENT, TEST AND QUALIFICATION PROGRAM

In this alternative, the Air Force Program Manager elects to procure newly designed equipment and supporting publications/data. A complete array of military specifications is imposed upon the manufacturer.

To produce the documentation required by this alternative, the publications department must first bid and then produce the data. These tasks are listed in the following paragraphs.

A. Bidding

1. Determine scope of effort. Exactly what data items are required: schematic diagrams, outline and mounting drawings, source data, instruction books, etc?

2. Research cited specification. Is specification valid for data item, and is it the latest version? Interpretation of poorly written specifications is one of the most difficult tasks for publications.

3. Determine depth of coverage. This will be based on the maintenance concept: organizational, intermediate, or overhaul.

4. Prepare a brief outline based on the cited specification.

5. Prepare a job estimate. This will include total man hours and cost based on the scope of effort.

I FULL MILITARY DESIGN, DEVELOPMENT, TEST AND QUALIFICATION PROGRAM
(CONTINUED)

B. Military Publication Procedures

   1. Determine if military nomenclature has been assigned
       by customer.

   2. Determine if general purpose test equipment has been
       approved by customer.

   3. Determine if special purpose test equipment has been
       approved by customer.

   4. Determine delivery requirements (manuscript,
       reproducible copy, negatives, printed books, source
       data, etc.).

   5. Review cited specification. Prepare a detailed
       outline if required by the specification or publications
       manager.

   6. Submit detailed outline (if required) for approval.

   7. Contact design engineer to coordinate data search.

   8. Research data, write text, and plan/prepare illustra-
       tions.

   9. Schedule validation. Notify DCASMA, design engineer,
       and others required.

   10. Perform validation. Fill out Validation Completion
       form. Correct manuscript as required.

11. If publication contains a part list, perform a compatibility check between the schematic diagrams and the parts list. Correct manuscript as required.

12. If publication contains a part list, incorporate SMR (source maintainability, and recoverability) codes.

13. Submit manuscript to design engineer, metrology, product integrity, program manager, quality control editor, etc. for review. Correct manuscript as required.

14. Submit manuscript for customer approval.

15. Review and evaluate customers review comments. Correct manuscript as required.

16. Submit manuscript to quality control editor for review.

17. Forward manuscript (text and drawings) to editing/composing.

18. Editing/composing prepares deliverable item (reproducible copy, negatives, printed matter, etc.).

19. Publications quality assurance editor checks deliverable item for specification compliance and corrects as required.

20. DCASMA inspects deliverable item. Corrections are made if required.

I **FULL MILITARY DESIGN, DEVELOPMENT, TEST AND QUALIFICATION PROGRAM (CONTINUED)**

21. Data support manager forwards deliverable item to customer.

22. Customer accepts/rejects deliverable item.

II COMMERCIAL OFF-THE-SHELF EQUIPMENT WITH MILITARY TEST, VERIFICATION, AND QUALIFICATION PROGRAM

In this alternative, the Air Force Program Manager elects to procure commercial off-the-shelf equipment, but he imposes military specification requirements for all publications/data. In this case, the same tasks listed for alternative I will apply.

The man-hours required to produce these military publications/data will be less than alternative I because most of the required data will be available in commercial format. This information will have to be reformatted to conform to the cited military specification. New data will be generated to satisfy additional requirements.

III COMMERCIAL OFF-THE-SHELF EQUIPMENT WITH COMMERCIAL VERIFICATION
AND DOCUMENTATION

In this alternative, the Air Force Program Manager elects to
procure commercial off-the-shelf equipment and publications/data
without additional tasks. The program manager assumes risks that
the commercial publications/data will not completely satisfy
Air Force requirements. Some of these risks are listed in
paragraph C.

The following tasks are performed to develop a commercial
publication. These tasks may be compared to alternative I
(a military publication). The publications department must
first bid and then produce data.

A. Bidding

1. The scope of effort is determined by the program
office.

2. The publication specification is an in-house
Rockwell-Collins standard.

3. The depth of coverage is determined by the equipment
design, maintainability recommendations, and available
general and special purpose test equipment.

4. A publication outline is not required due to the
familiarity with the Rockwell-Collins publication
standard.

5. Prepare a job estimate. This will include total
man hours and cost based on the scope of effort.

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III COMMERCIAL OFF-THE-SHELF EQUIPMENT WITH COMMERCIAL VERIFICATION
AND DOCUMENTATION (CONTINUED)

B. Commercial Publication Procedures

1. Determine if commercial nomenclature has been assigned locally.

2. Determine if general purpose test equipment has been approved by metrology and engineering.

3. Determine if special purpose test equipment has been approved by engineering.

4. Delivery requirements are printed books required by commercial/military customers to support the equipment.

5. Review Rockwell-Collins publication specification. A detailed outline is not required due to the familiarity with the in-house specification.

**6. Detailed outline approval is not required since none is written.

7. Contact design engineer to coordinate data search.

8. Research data, write text, and plan/prepare illustrations.

9. Schedule validation. Notify design engineer and others required.

10. Perform validation. Fill out Validation Completion form. Correct manuscript as required.

III. COMMERCIAL OFF-THE-SHELF EQUIPMENT WITH COMMERCIAL VERIFICATION
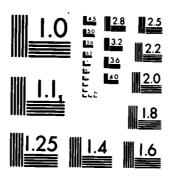   AND DOCUMENTATION (CONTINUED)

   11. Perform a compatibility check between the parts

       list and the schematic diagrams. Correct

       manuscript as required.

 **12. SMR (source, maintainability, and recoverability)

       codes are not used in a commercial parts list.

   13. Submit manuscript to design engineer, metrology,

       product integrity, pro·'·am manager, quality control

       editor, etc. for review. Correct manuscript as

       required.

 **14. Customer approval not required.

 **15. Customer review comments not available.

   16. Submit manuscript to quality control editor for final

       review.

   17. Forward manuscript (text and drawings) to editing/composing.

   18. Editing/composing prepares manuscript for printing.

   19. Publication is printed and forwarded to Central

       Distribution Center for distribution/storage.

 **These procedures are not performed for commercial publications.
   They are included for comparison with military publication procedures.

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

III COMMERCIAL OFF-THE-SHELF EQUIPMENT WITH COMMERCIAL VERIFICATION
AND DOCUMENTATION (CONTINUED)

C. Risks

When comparing alternative I (military) to alternative III
(commercial) publication/data procurement, the following
risks are taken.

1. The maintenance concept (depth of coverage) may
    not be appropriate.

2. The general purpose test equipment may not be
    available in Air Force inventory.

3. The special purpose test equipment must be evaluated
    and procured.

4. The publication/data may cover several models not
    procured by the Air Force.

5. The parts list will not contain SMR codes.

6. The right to revise the material is vested in the
    manufacturer.

7. Revision service must be requested to provide for
    updating.

8. A record of validation may not be available.

IV COMMERCIAL OFF-THE-SHELF EQUIPMENT TO COMMERCIAL SPECIFICATIONS WITH RECOMMENDED TASKS TO REDUCE RISKS

In this alternative, the Air Force Program Manager elects to procure off-the-shelf equipment and publications/data to commercial specifications. He also wishes to reduce the risks associated with the procurement of publications/data to satisfy military requirements. First, a careful review of the commercial off-the-shelf publication is required. Second, the information provided by the review is used to provide recommendations that will reduce risks.

A. Review

MIL-M-7298C is the basic military specification for reviewing the minimum requirements for acceptable commercial manuals for use by all departments and agencies of the Department of Defense to install, operate, and maintain commercial equipment. This is a fairly good general specification written in broad general terms. It does not address many of the differences between military and commercial publications/data.

To ensure that commercial publications meet Air Force requirements, military specification MIL-M-7298C and the following items should be carefully reviewed.

1. Is the depth of coverage (organizational, intermediate, or overhaul) appropriate?

2. Is the general purpose test equipment, or equivalent, available in Air Force inventory?

3. Is the special purpose test equipment, or equivalent,

available in Air Force inventory?

4. Does the publication cover only those models of

equipment procured by the Air Force?

5. Does the parts list section satisfy Air Force

requirements? Are SMR codes required or desired.

6. Will the manufacturer revise, update, and add an

Air Force technical order number to the publication/

data to satisfy the Air Force requirements?

7. Will the manufacturer provide a record of validation?

The Air Force should verify publication/data before

approval.

B. Recommendations

After carefully reviewing the commercial publications/data,

the following procurement options are recommended for the

Air Force Program Manager.

1. Purchase the existing publications/data. If the

commercial publications/data meets the essential

Air Force requirements, the program manager may wish

to procure the existing publications/data without

change.

IV <u>COMMERCIAL OFF-THE-SHELF EQUIPMENT TO COMMERCIAL SPECIFICATIONS WITH</u>
<u>RECOMMENDED TASKS TO REDUCE RISKS (CONTINUED)</u>

2. Negotiate changes to the existing publications/data.
    Most commercial manuals will not satisfy all Air Force
    requirements. The program manager should negotiate
    with the manufacturer to incorporate the essential
    Air Force requirements into the existing publications/
    data. This option will result in substantial savings
    when compared to purchasing publications/data prepared
    to military specifications.

3. Purchase new commercial specification publications/data.
    If the program manager determines that recommendations
    1 and 2 are not feasible, he may purchase a new
    commercial publications/data using the existing
    commercial manual for source data. A savings can
    be realized when compared to purchasing publications/
    data prepared to military specifications.

A3.4.4 Quality Assurance

The basic Quality Assurance Program tasks necessary to fulfill the requirements of a specific program or contract are listed in Table A4.2 For each of the four alternative program types listed in Table A4.3, a QA Program consisting of all of these tasks is required. The level of effort required to support each of the four alternative program types is shown as a percentage of the effort required to support a full military specification design effort. Each of these Quality Assurance Programs would, in effect, be basically the same regardless of equipment type (communications, data processing, etc.) or equipment environment (Airborne Tactical Fighter, Transport, or Ground Support). The only difference in each of these programs would be the amount of effort required to ensure equipment quality and performance meets the specific requirements imposed by each of these categories. This effort would depend on the actual technical requirements for performance, design, development, test, and compatability of equipment as defined in the procurement specification. Given the same technical requirements for a specific piece of equipment, the amount of effort required to support a Quality Assurance Program for each of the four alternatives listed would then be a function of the percent of effort required to ensure conformance to each of the military specifications imposed by the contract.

The major cost differential between each of the alternative programs shown can be attributed to the design effort required in Alternative I. This effort would include Preliminary and Critical Design Reviews, Program Reviews, Physical Configuration Audit, First Article Inspection, Functional Configuration Audit, and Product Readiness Reviews. In addition to these tasks, there would be increased Quality Assurance support for Engineering, Engineering Lab

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Inspection, and Manufacturing during the design and development phase of the contract. Since Alternatives II, III, and IV relate to commercial off-the-shelf equipments, it is assumed that there is no additional design effort and that this effort is included in the catalog or contract purchase price. Additional cost differences between programs requiring full military verification, qualification and testing (Alternatives I and II) and those requiring commercial or recommended support (Alternatives III and IV) result from the reduced effort, in the second two alternatives, required to support MIL-STD-1520 A/B activity, MIL-STD-965 activity, production Reliability Testing, and Quality Assurance Reports and data items. In Alternative III (Full Commercial Program) these activities would be implemented through the use of in-house developed Quality standards and operating procedures. In Alternative IV (recommended verification, qualification, and testing) these tasks would be accomplished through the use of military specifications in conjunction with established in-house procedures covering extended Equipment Burn-In, Reliability Demonstrations, Production Qualification Testing, and Maintainability Demonstration Programs.

The Quality Program requirements set forth in the Quality plans for each of the four alternatives, and the level of effort required to support these plans, are established to ensure an effective and economical Quality Program. The increased Quality Assurance costs associated with Alternatives I and II reflect the increased effort required to support the additional qualification, verification, and testing necessary to ensure the equipment meets the additional requirements imposed by a military program. This increased effort aids in the early detection of both product and process deficiencies and provides for prompt corrective action. The use of extended Burn-In and Production Reliability Testing provides for increased detection of infant mortality and monitoring of equipment MTBF. In addition to these tasks,

the Quality Assurance Program would also include part procurement quality and usage requirements to ensure the equipment design meets the environmental requirements imposed by the contract. Since the first two alternative programs include the full range of military qualification, verification, and testing, the inherent risks involved in the use of a commercial design as outlined in Alternative II would relate directly to the requirements imposed during the design effort. This would include selection of parts, operational requirements, environmental requirements, and technical specifications for equipment design.

The reduced level of effort required to support a full commercial program as shown in Alternative III reflects the reduced monitoring effort during the production phase. Environmental, Reliability, and Qualification Testing is typically performed during the design phase to verify equipment operational parameters, ensure compliance with federal regulatory agencies' requirements (FAA, FCC, etc.), and to establish equipment MTBF's. Once in production, most of these tests are not repeated unless major design changes are incorporated in the equipment or field performance warrants the re-evaluation of parameters evaluated by these tests.

A reduced burn-in program is implemented in production to reduce the level of infant mortality related failures and to periodically monitor equipment performance at the operating temperature extremes. Although the workmanship requirements may be relaxed from those imposed by a military program, sufficient inspection points are maintained throughout the manufacturing process to ensure good equipment quality. The risks involved in the use of commercial equipment must then be evaluated in terms of part quality (commercial vs. military), equipment design requirements (operating limits, temperature, altitude, humidity, etc.), and the monitoring and verification

testing conducted on production equipment (Rel. Sample Tests, Burn-In Requirements, etc.). It is these areas in which additional testing, inspection, and verification would be accomplished in Alternative IV to attenuate the risks involved in the use of commercial equipment. This effort would include the use of extended burn-in programs to increase the detection of infant mortality related failures and to monitor equipment performance throughout its environmental envelope. The use of a production Reliability Sampling Plan would also aid to verify equipment design characteristics and establish a product baseline by which equipment performance could be measured. In addition to these tasks, additional effort would be included to support Corrective Action Board, Material Review Board, and Customer Quality Interface activities.

QUALITY ASSURANCE PROGRAM TASKS

TABLE A3.2

1. Review and interpret the contract in regard to contractual Quality requirements.

2. Prepare Quality Plans and Reports as required by the contract.

3. Provide the program engineering function with an interpretation of contractual Quality requirements.

4. Provide Quality Assurance collateral support for the Engineering Lab and Engineering Lab Inspection function.

5. Monitor program quality and adherence to contractual requirements throughout the design and development phase through the use of Design Reviews, Physical Audits, First Article Inspections, and Product Readiness Reviews.

6. Provide QA support to the program office in coordinating contractual Quality requirements with Manufacturing.

7. Provide support for the resolution of Manufacturing and field problems as they arise. Coordinate the resolution with the Program Office, Manufacturing, Engineering, and other related departments.

8. Provide liaison between Rockwell-Collins personnel and customer Quality representatives for products requiring source inspection.

9. Monitor Qualification, Environmental, and Reliability Testing throughout the design, development, and production phases of the contract.

10. Maintain interface with DCASMA or other Government Quality Representatives on Quality Program requirements.

11. Receive, process, and answer customer complaints pertaining to Quality deficiencies.

12. Provide program Quality support for change Control Board activities.

13. Establish and chair the Material Review Board and provide Quality Assurance assistance in the disposition of nonconforming material.

14. Conduct Corrective Action Board Meetings on a regular basis with the Program Manager, Manufacturing Manager, Manufacturing QC Manager, and the Design Technical Director.

15. Provide Quality Engineering support for periodical process, procedure, and product audits to ensure conformance to contractual and company Quality requirements.

QUALITY ASSURANCE PROGRAM COST

TABLE A3.3

Alternative I - - - - - - - - - - -100%

Alternative II - - - - - - - - - - - 64%

Alternative III - - - - - - - - - - - 38%

Alternative IV - - - - - - - - - - - 51%

% of effort required to support a Quality Assurance Program for a full

military specification detailing design, development, and production requirements.

ALTERNATIVE PROGRAM DESCRIPTION

I. Design, development, test, and verification to military standards and specifications.

II. Commercial off-the-shelf design with military test, verification, and qualification program with normal military support.

III. Commercial off-the-shelf design at catalog price with normal commercial support.

IV. Commercial off-the-shelf design with qualification, verification, and test program recommended by Rockwell Collins.

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